

July 22, 1969

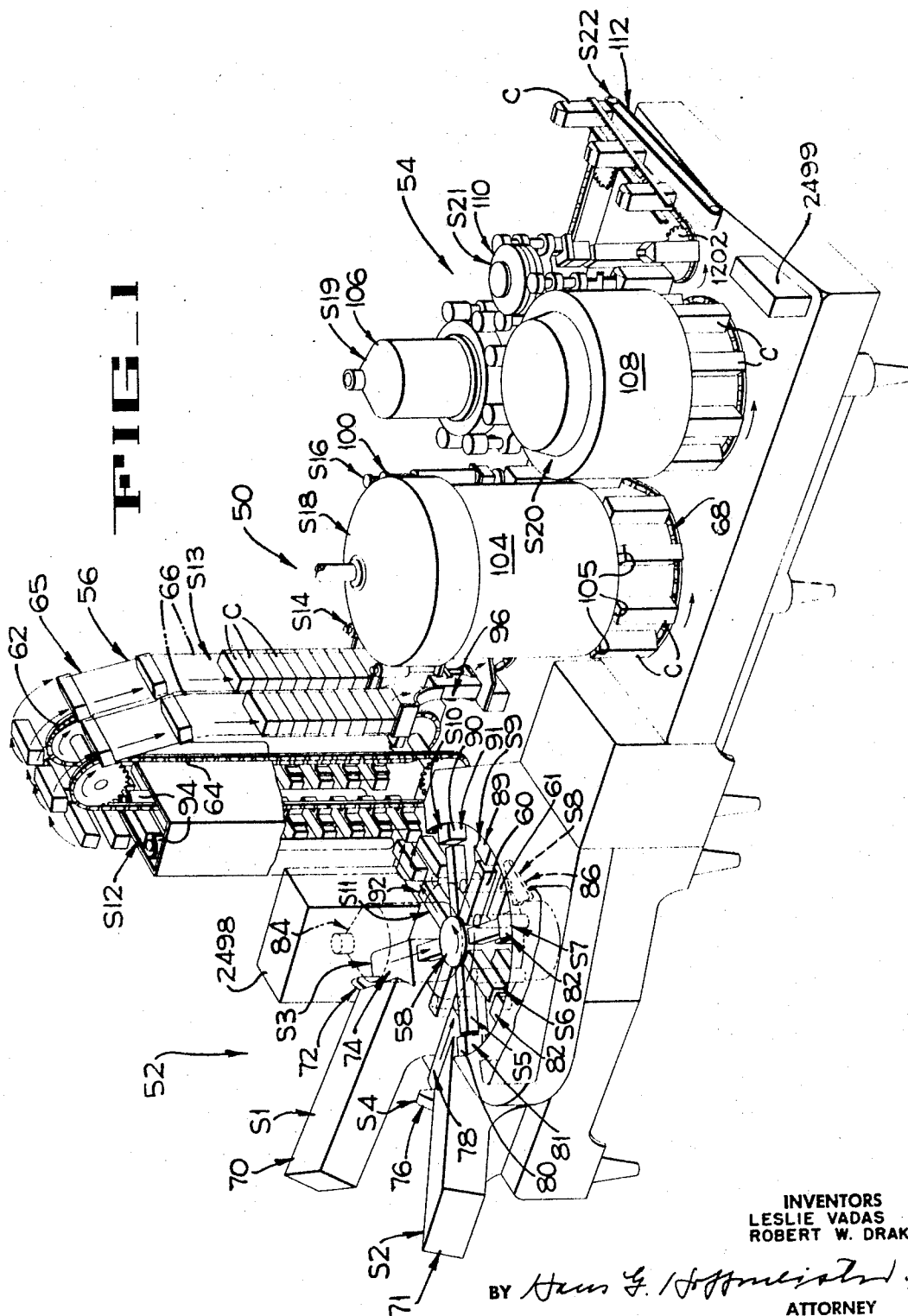
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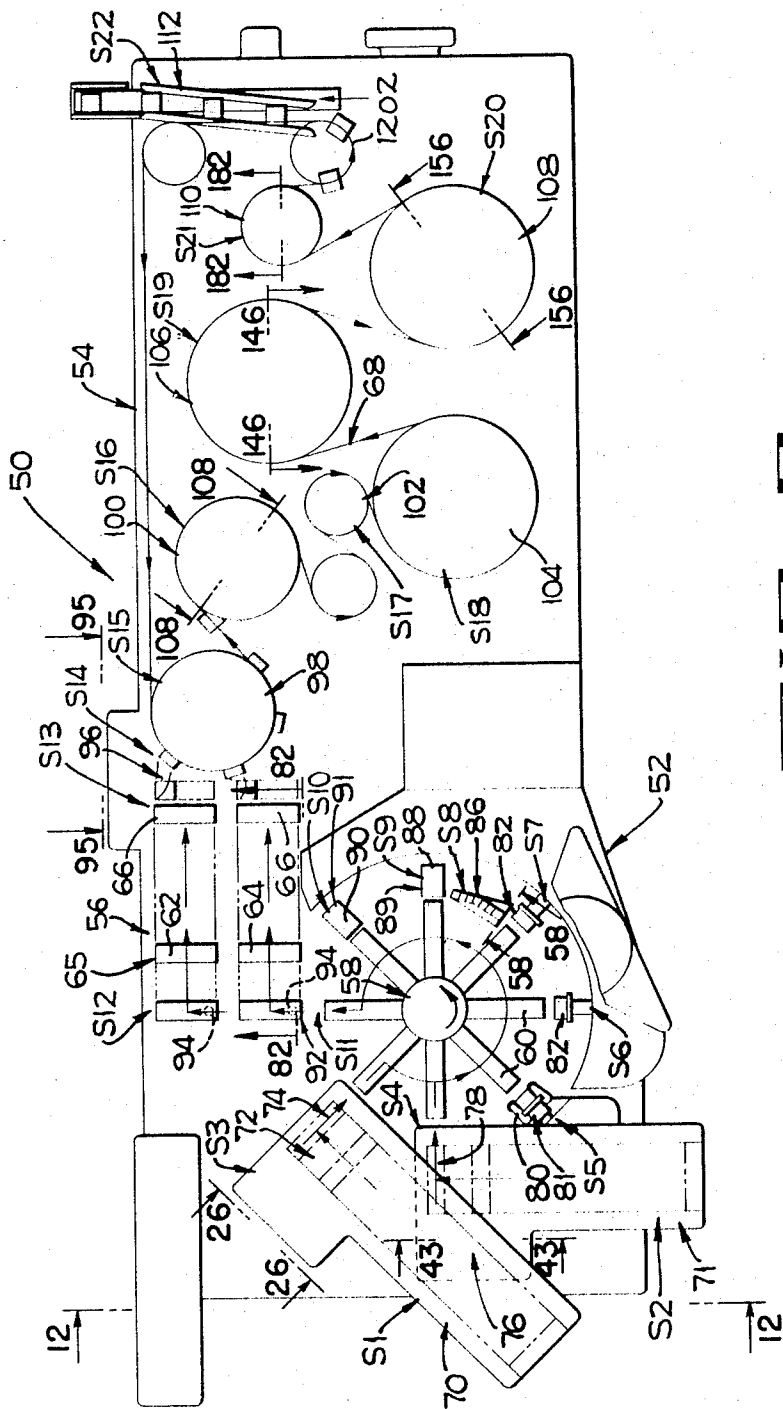


FIG. 2

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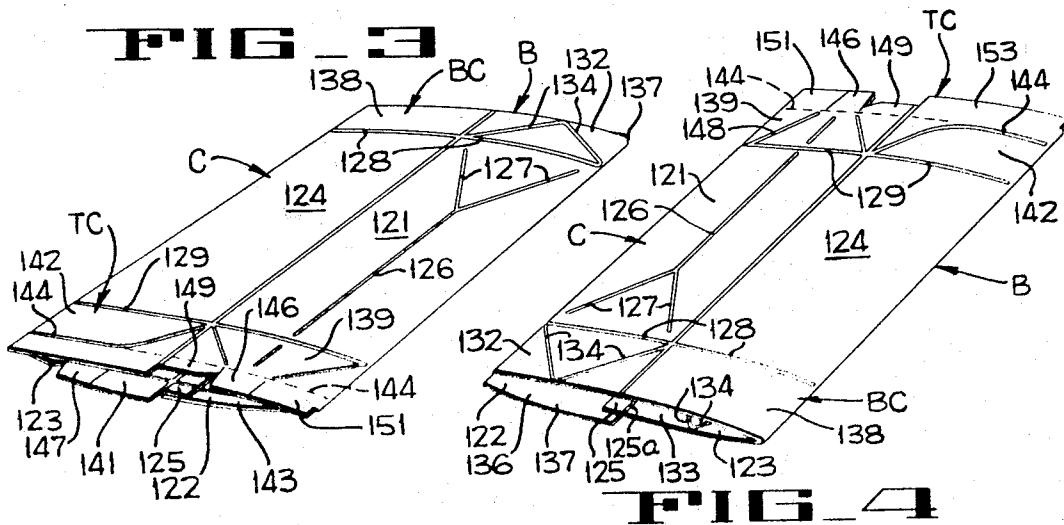
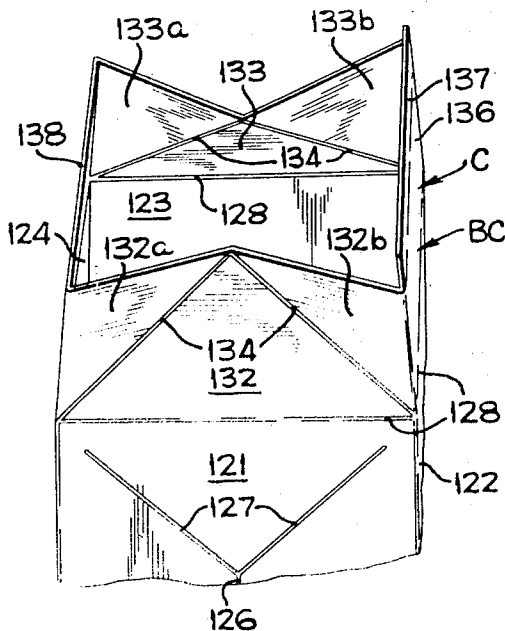
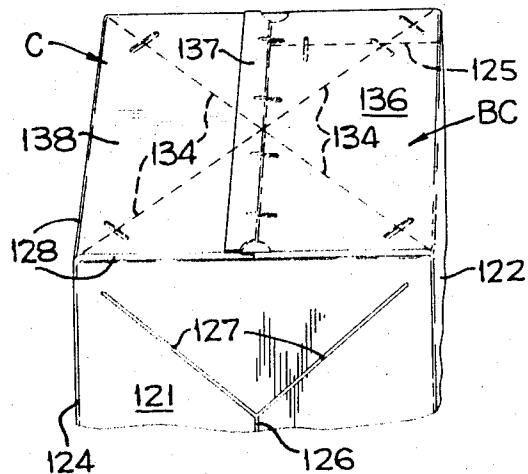
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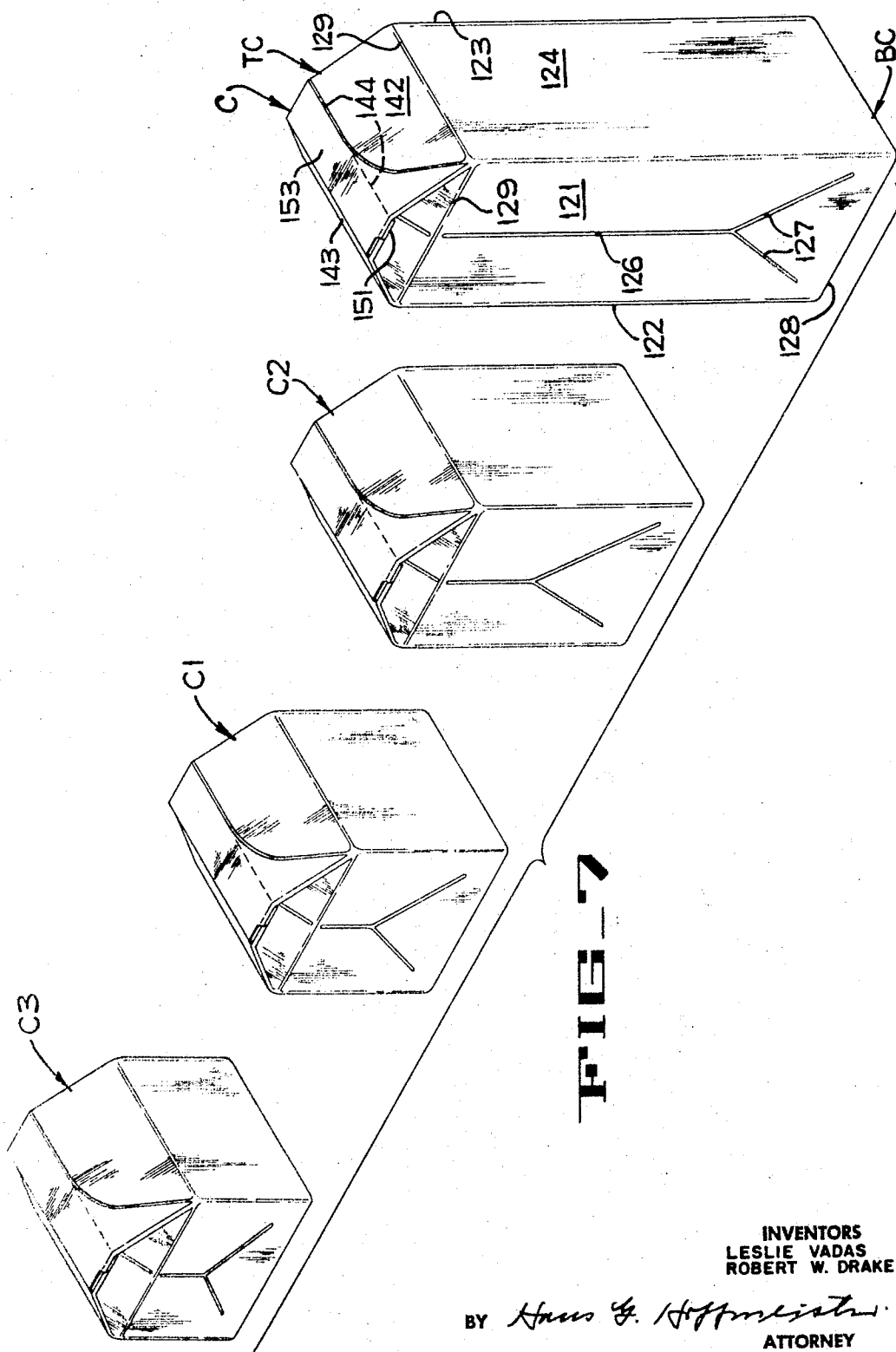
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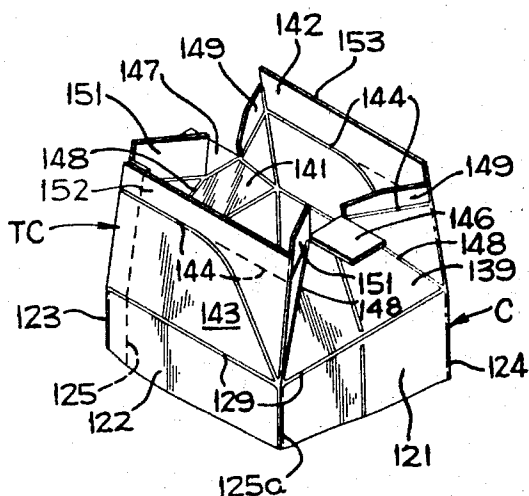


FIG. 8

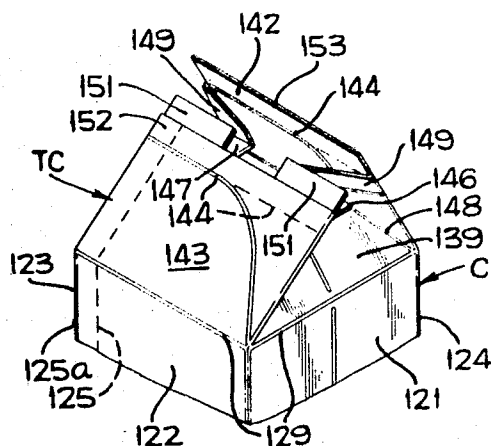


FIG. 9

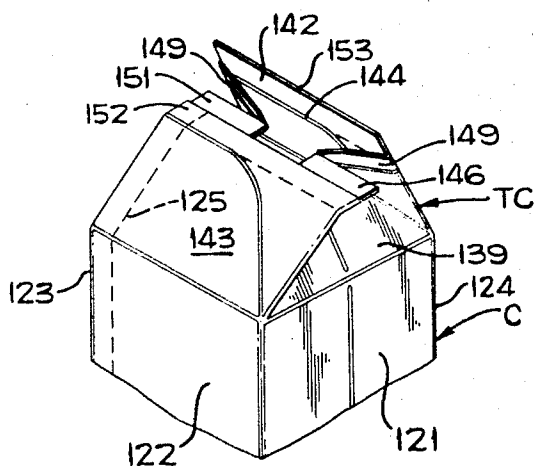


FIG. 10

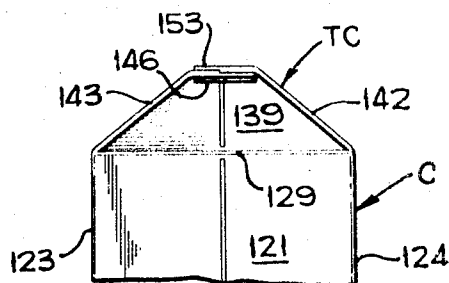


FIG_11

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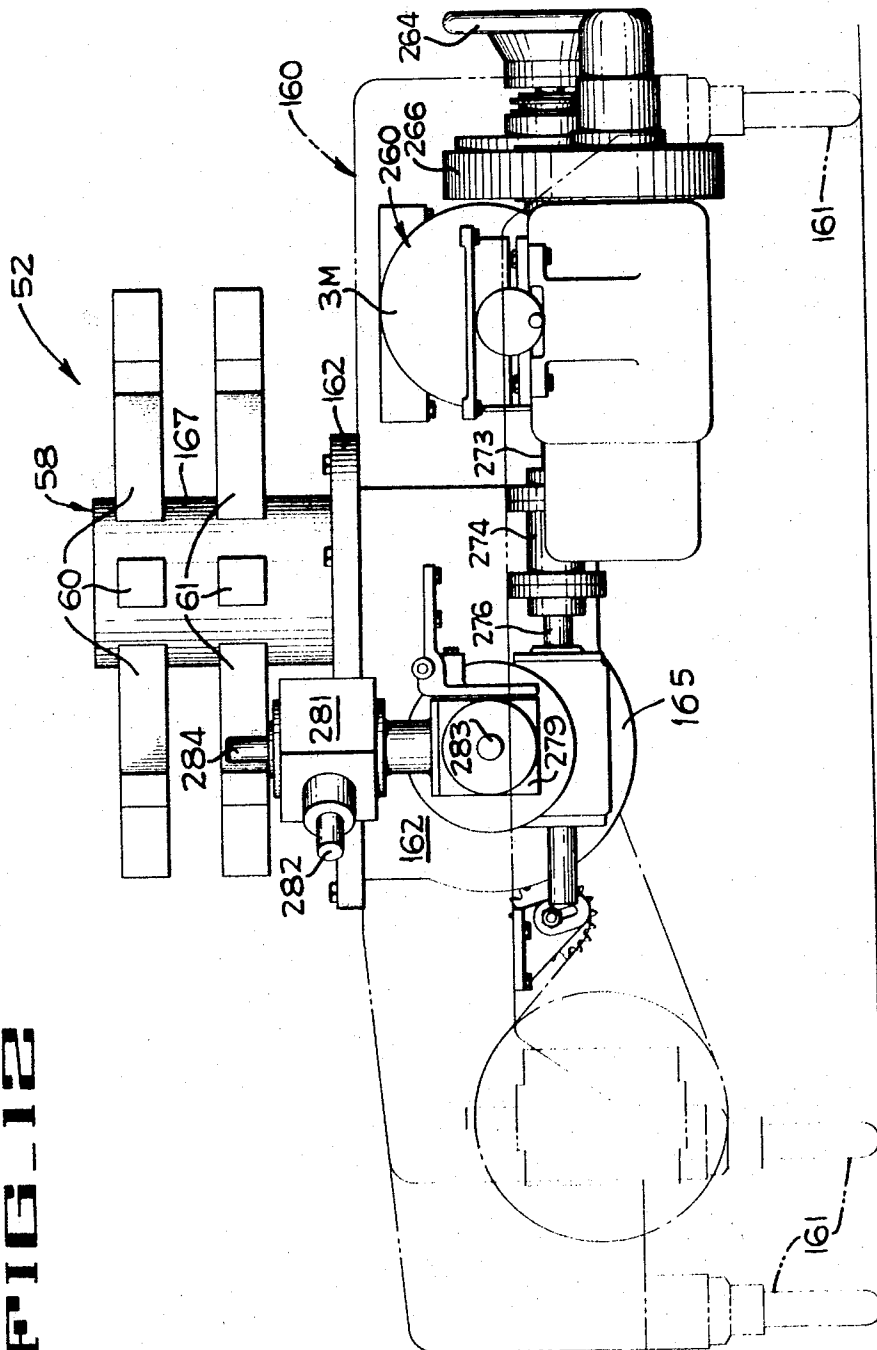
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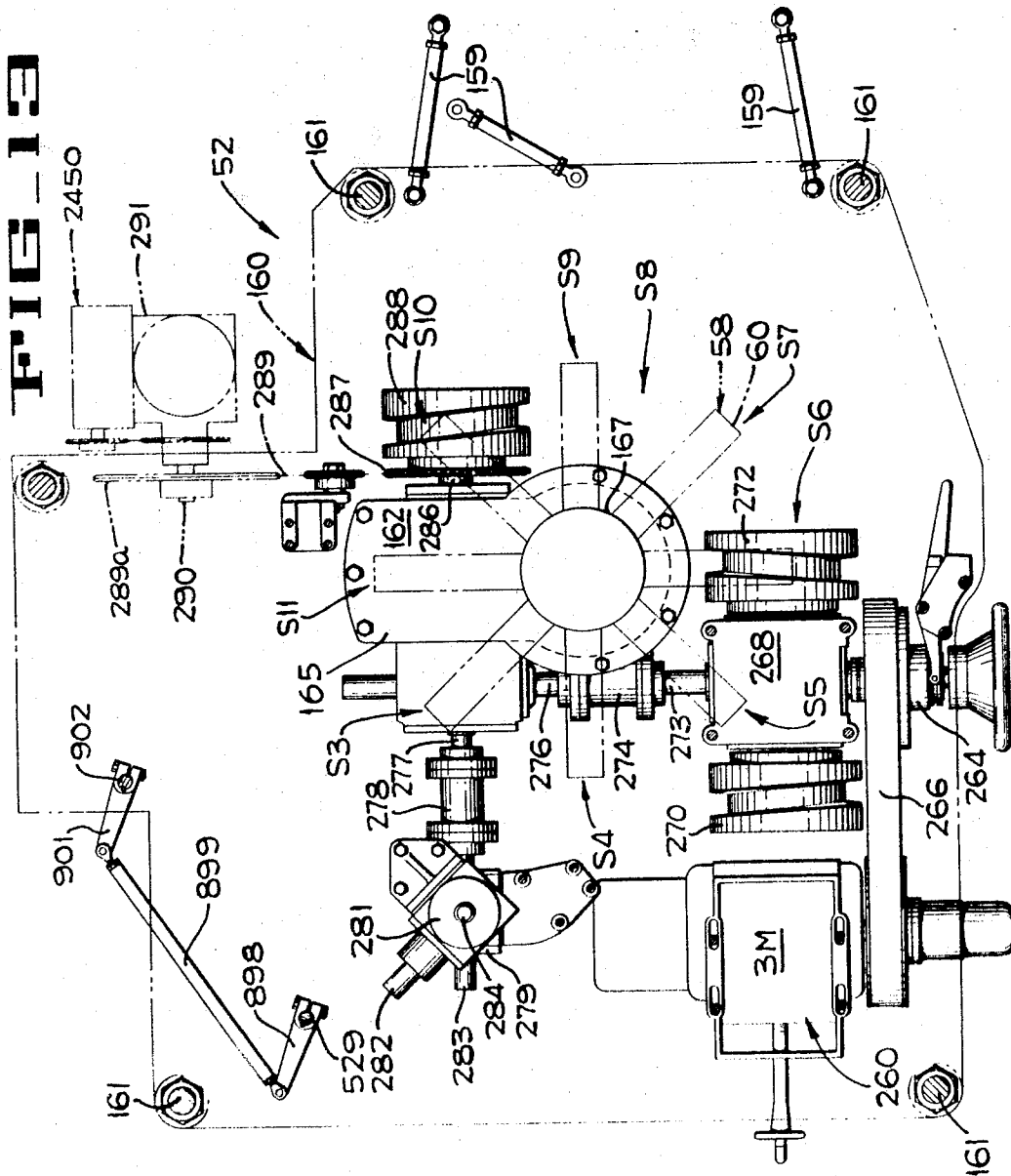
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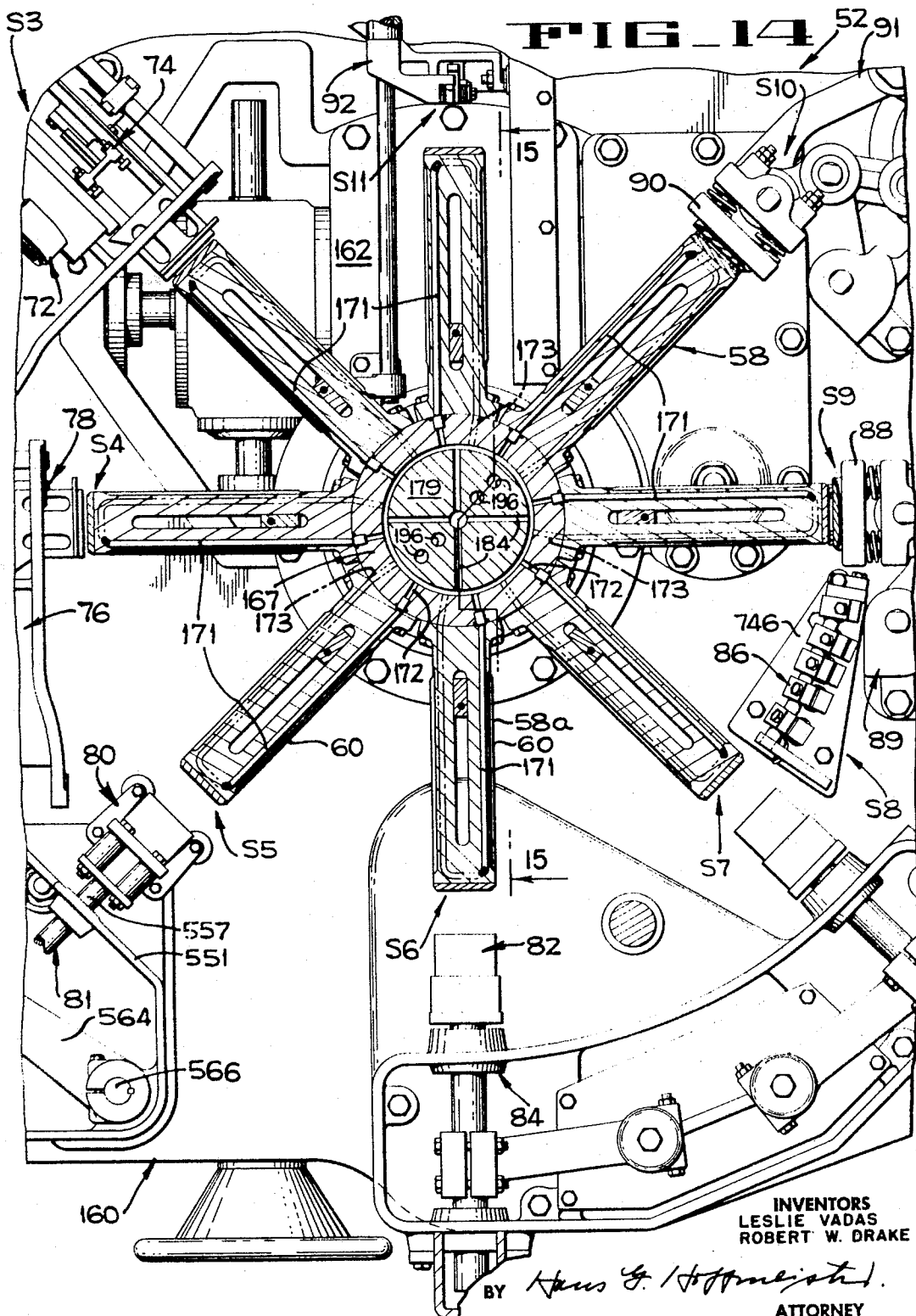


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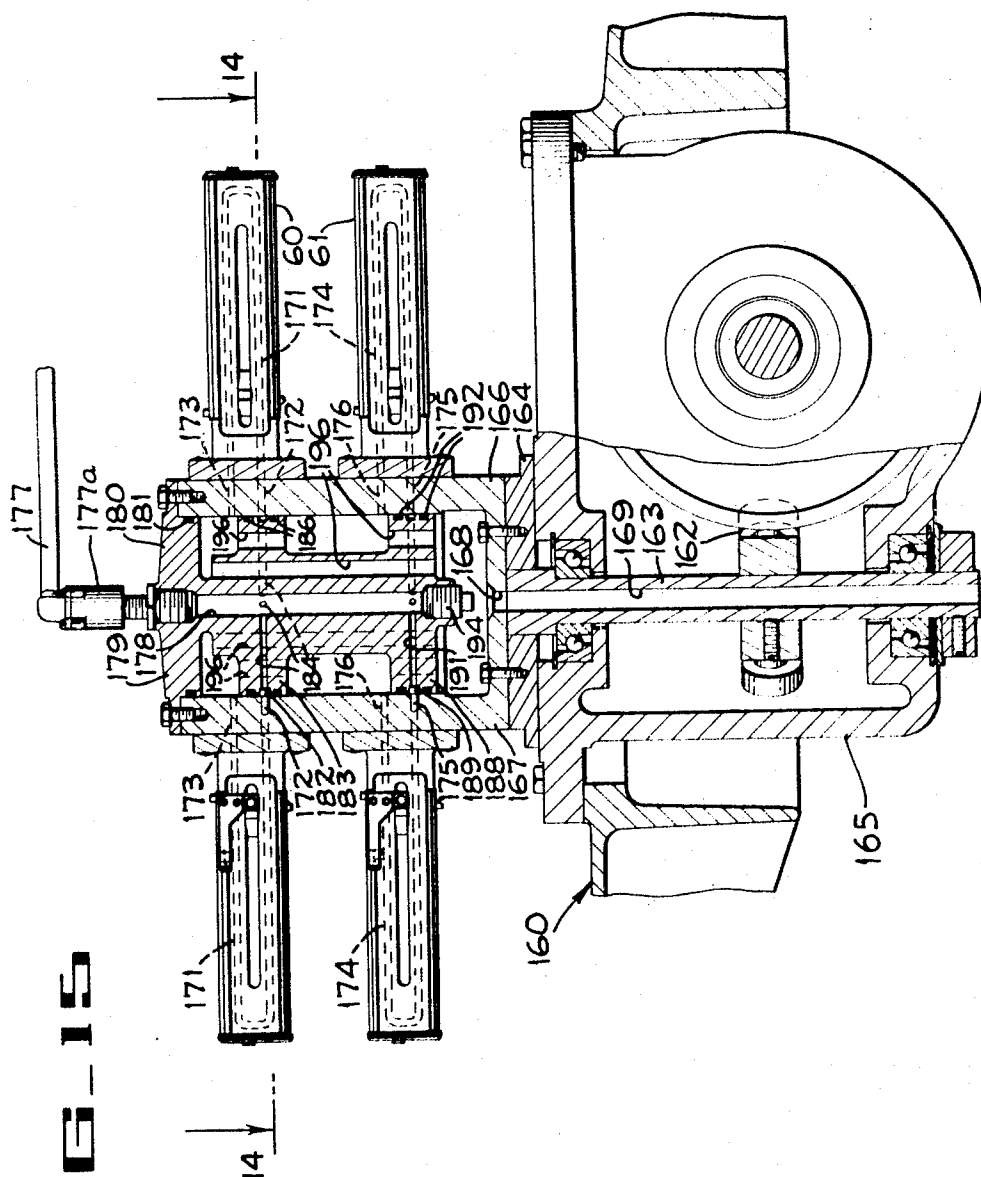


FIG-15

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FIG 16

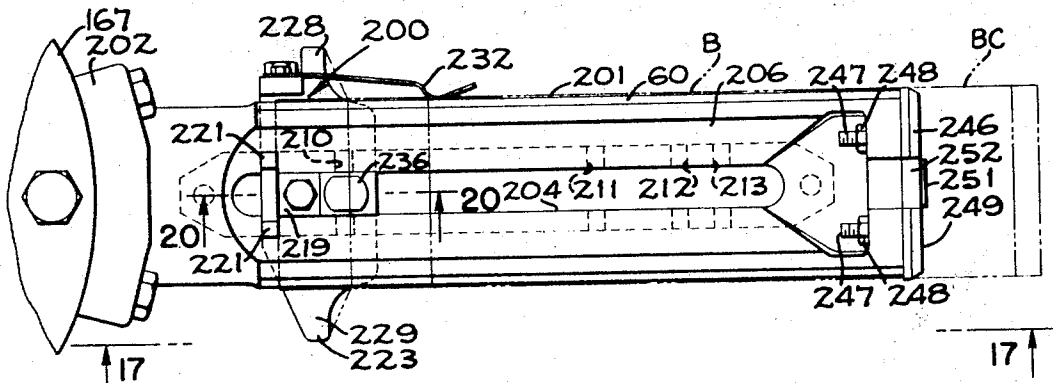


FIG 17

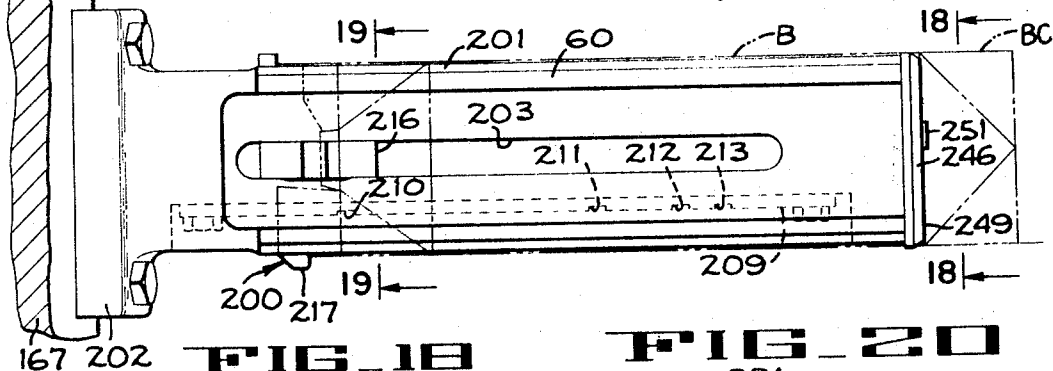


FIG 18

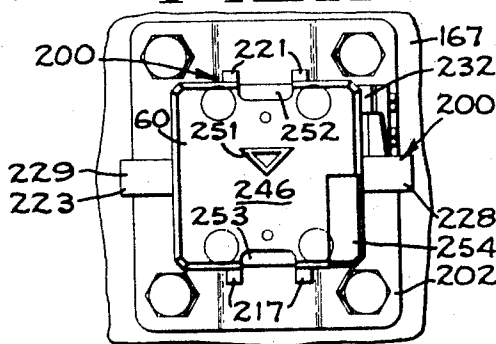


FIG 20

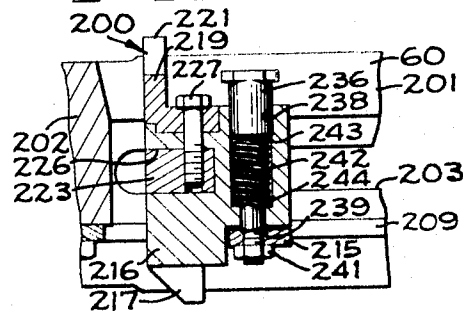


FIG 21

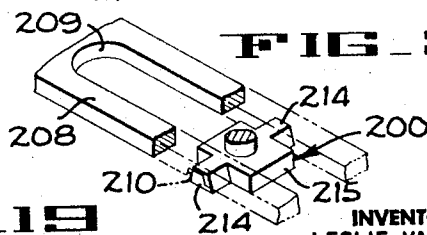
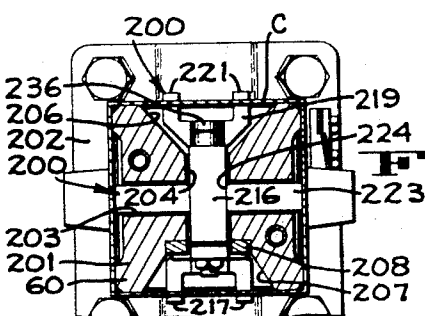


FIG 19



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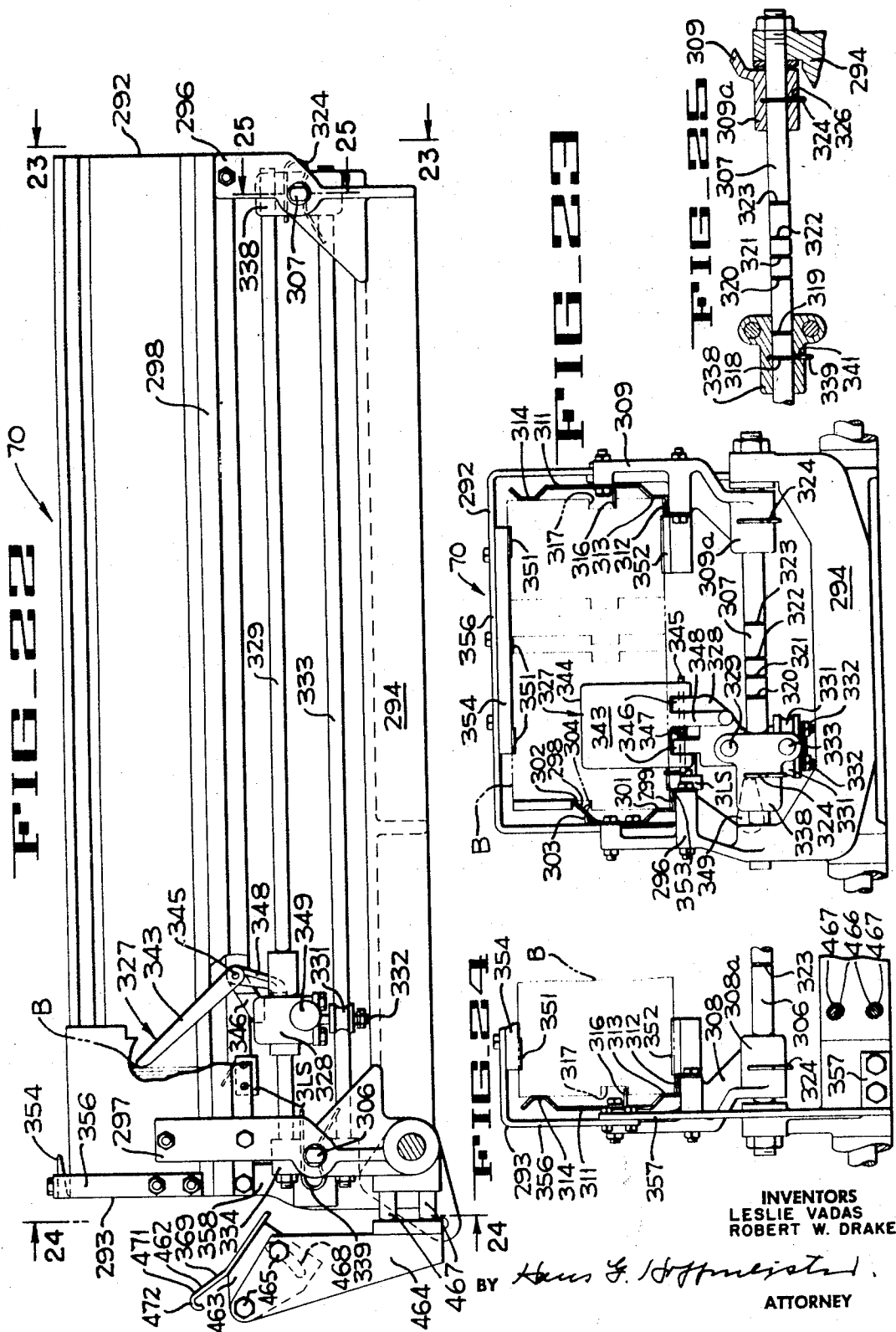
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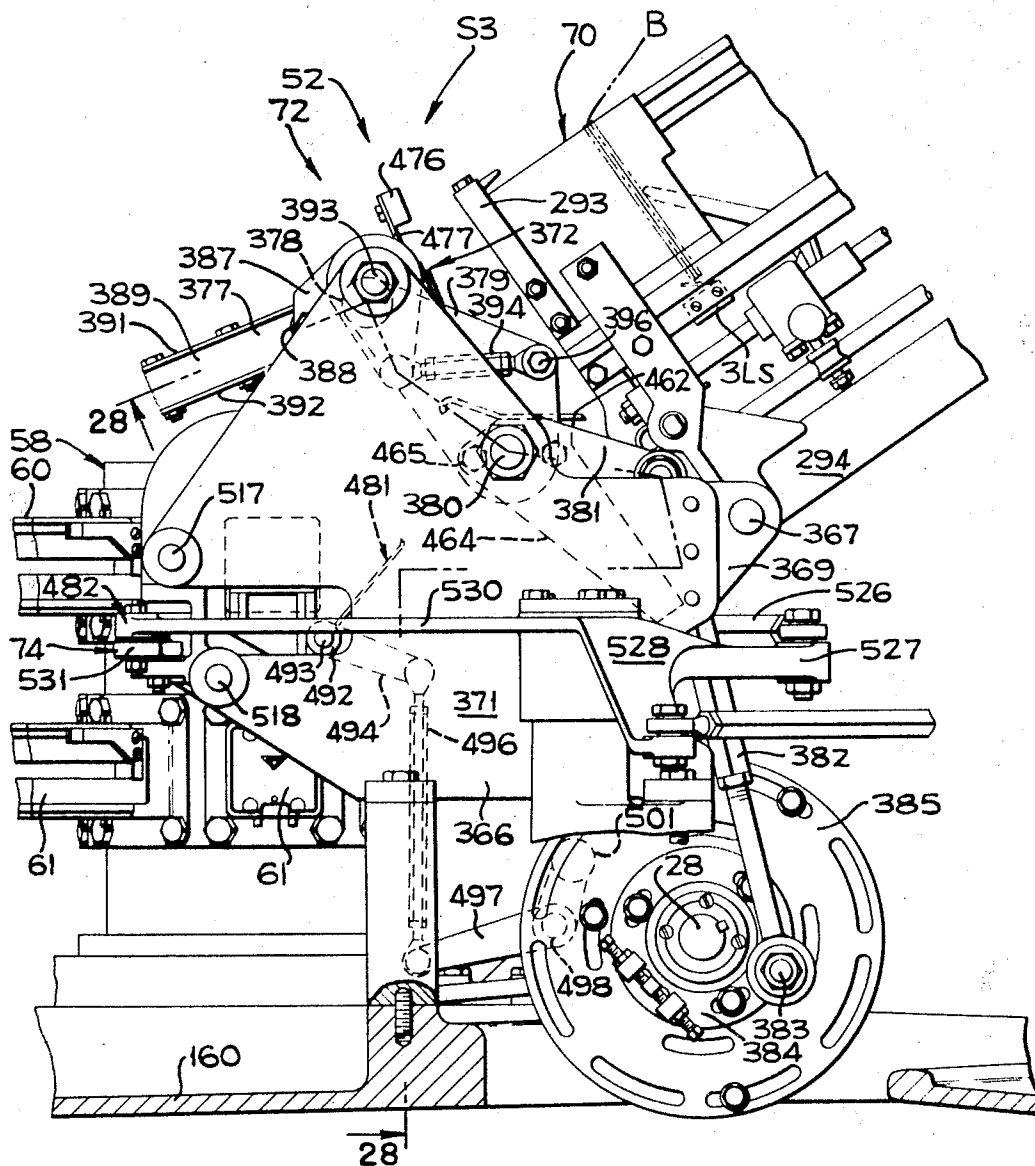


FIG. 26

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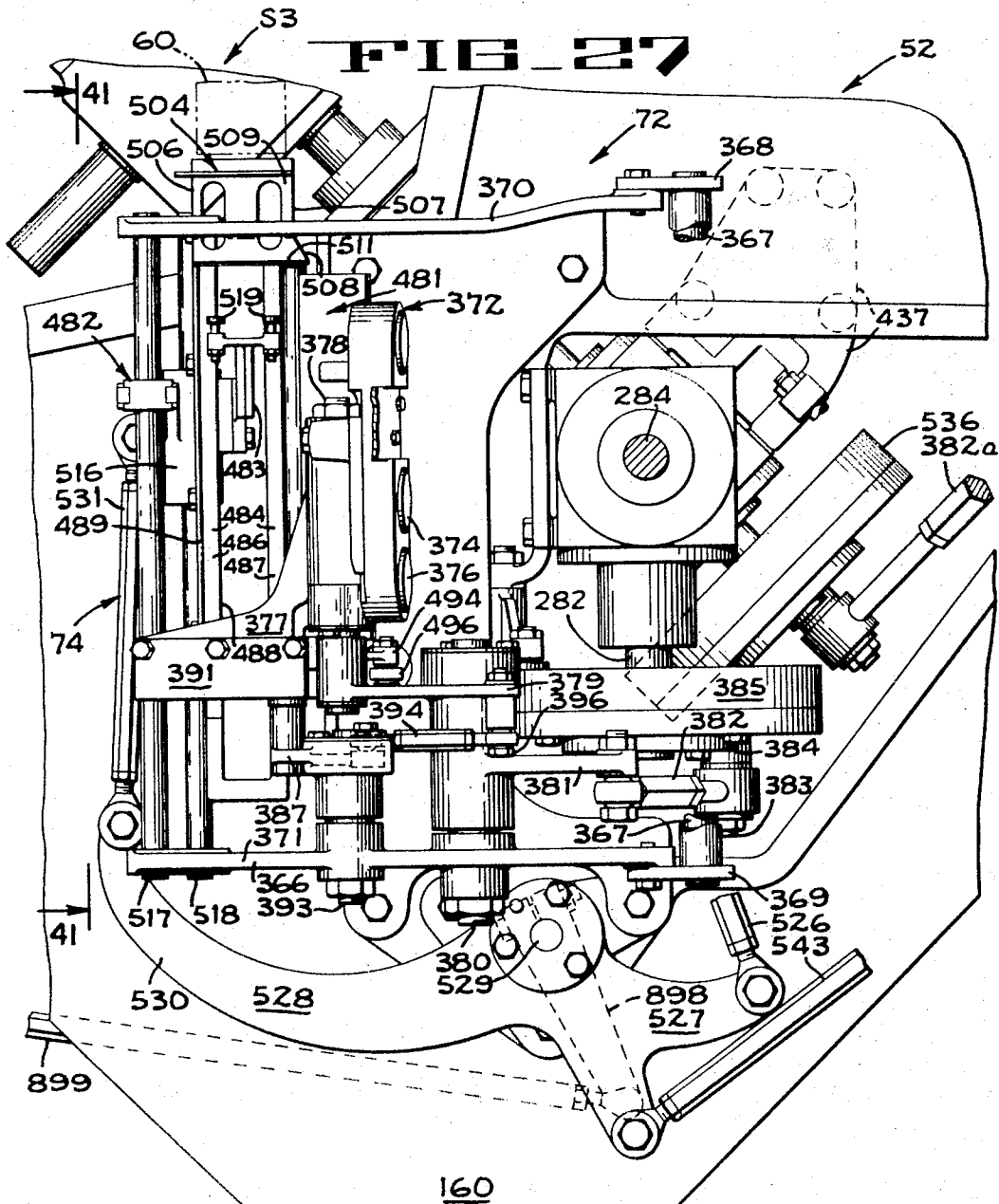
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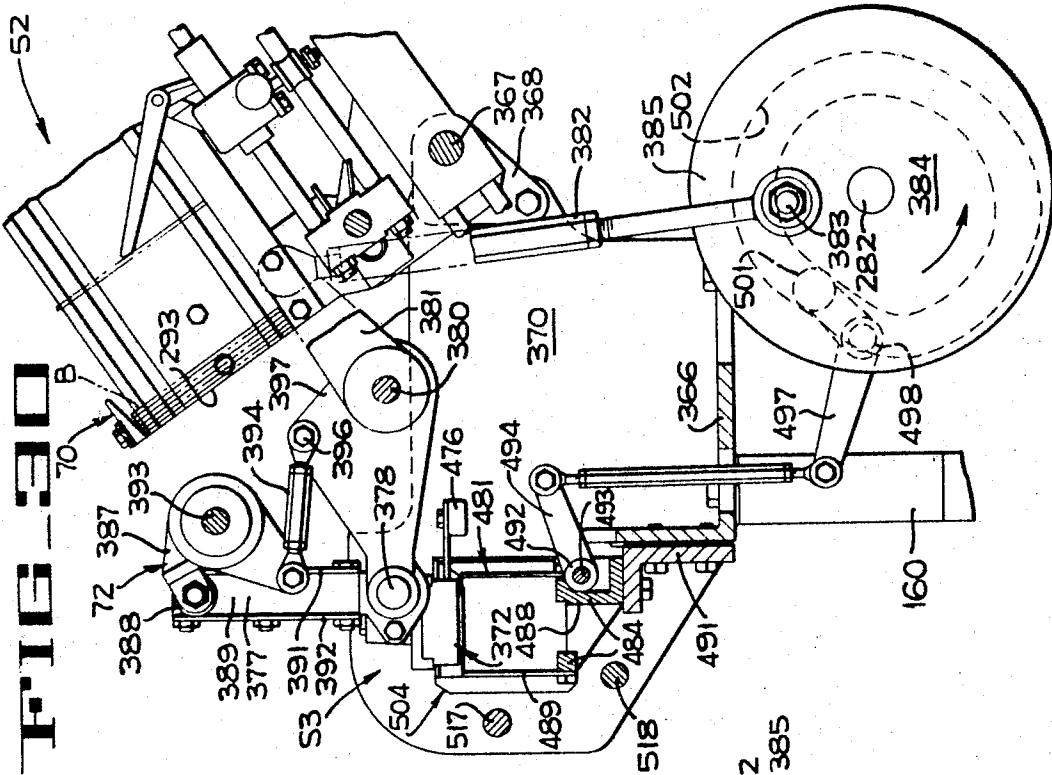
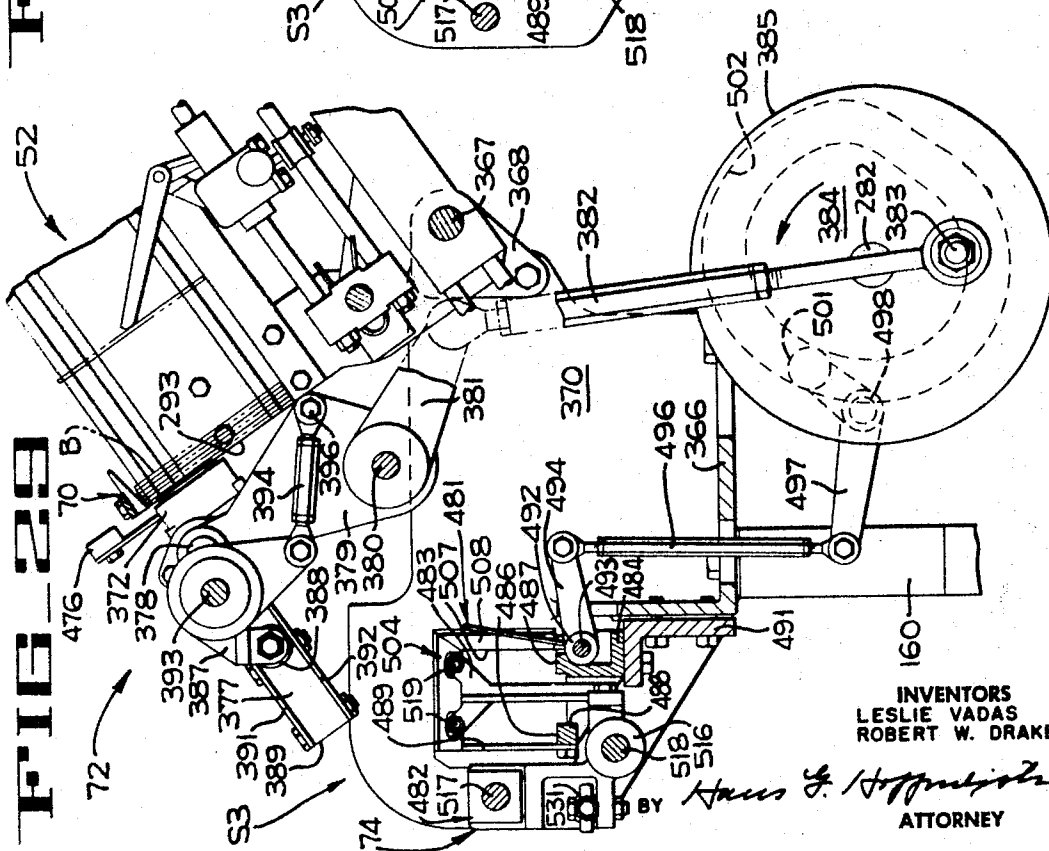
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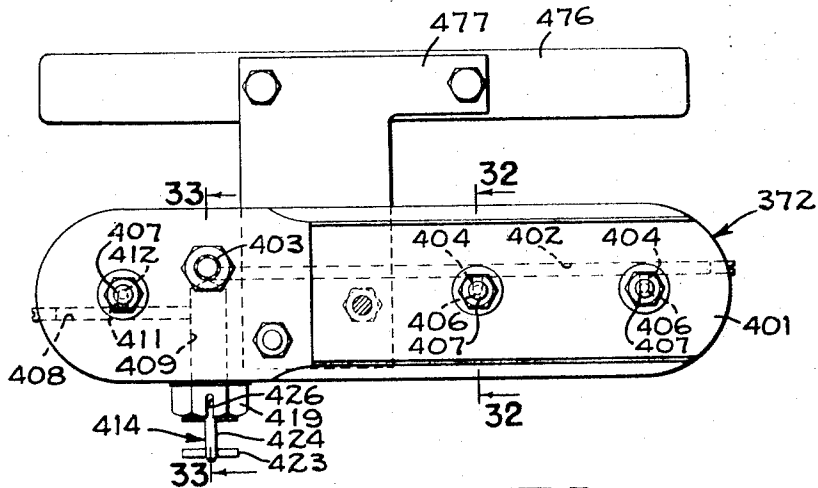


FIG. 31

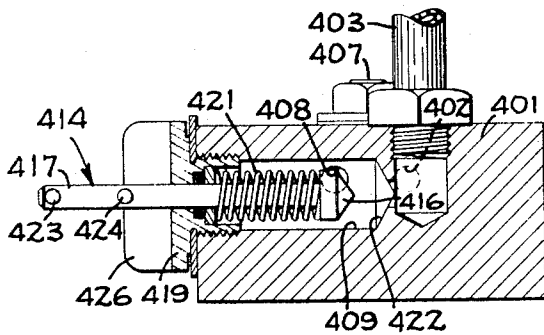


FIG. 33

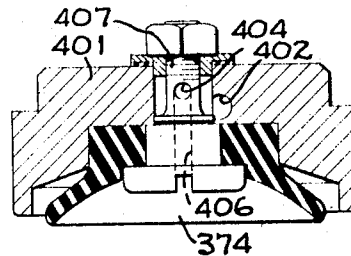


FIG. 32

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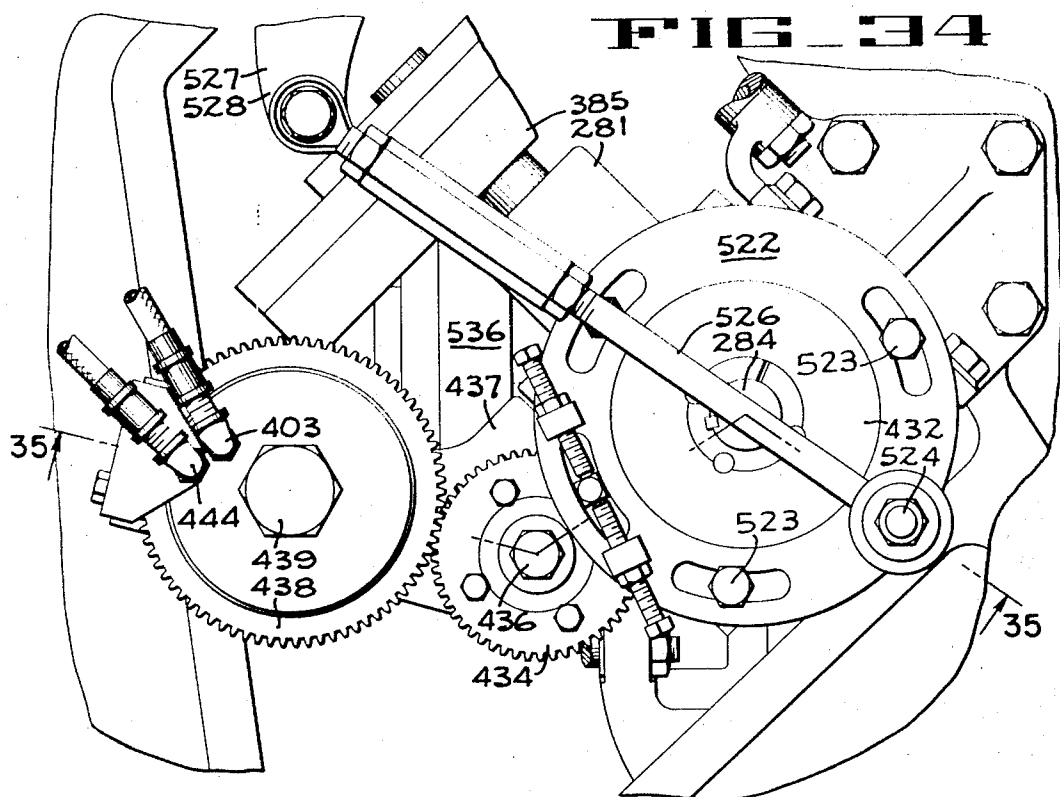
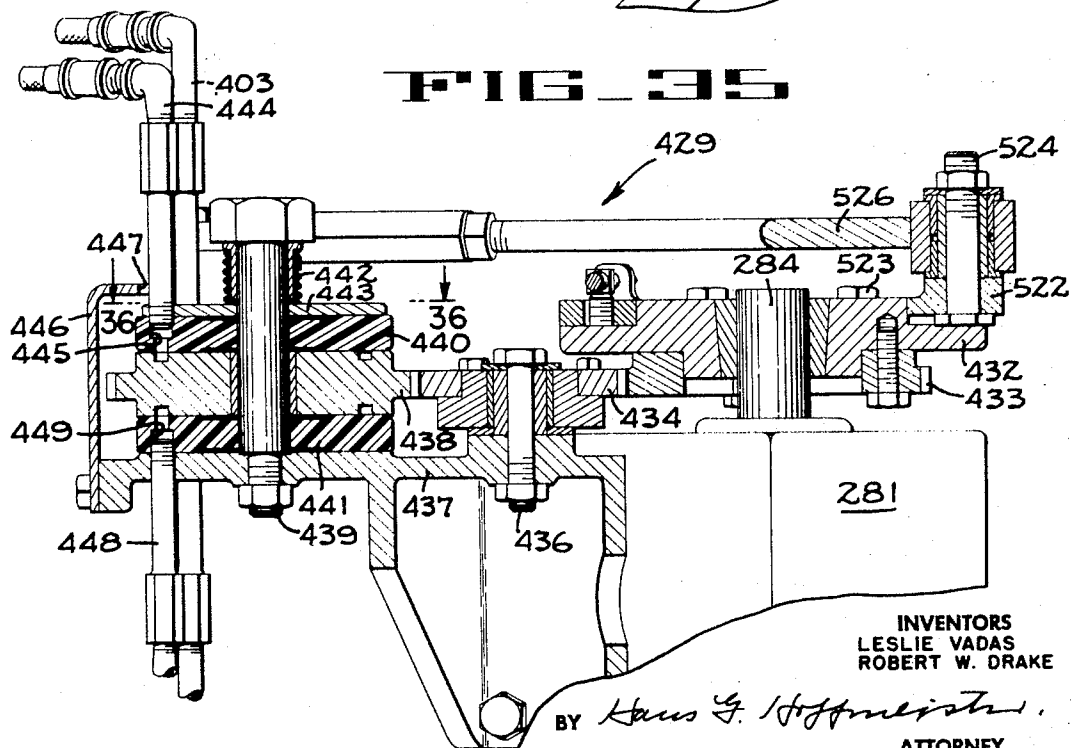
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FIG. 36

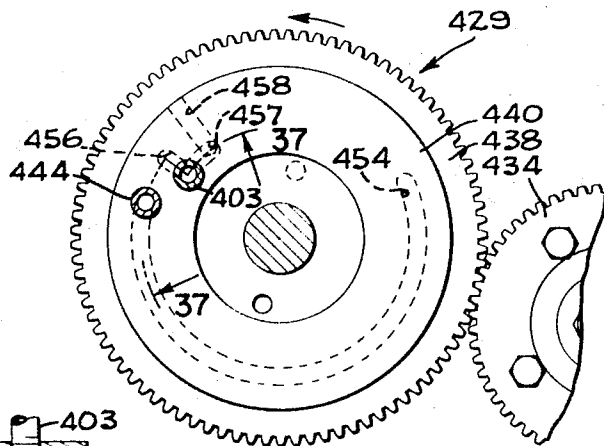
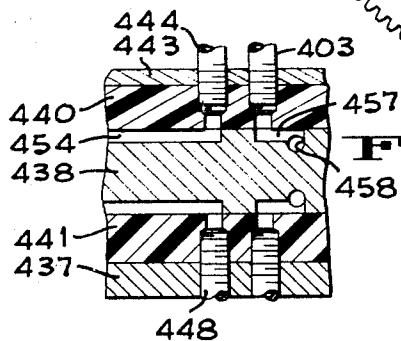


FIG. 37

FIG. 38

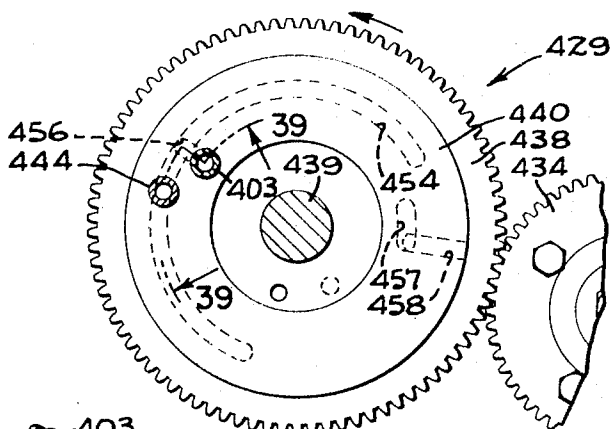
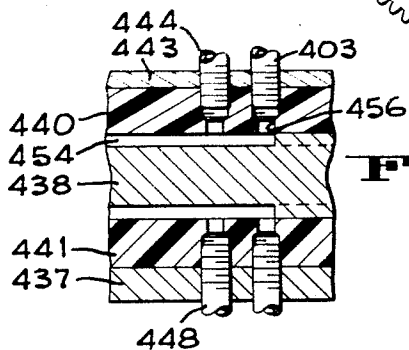


FIG. 39

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FIG 41

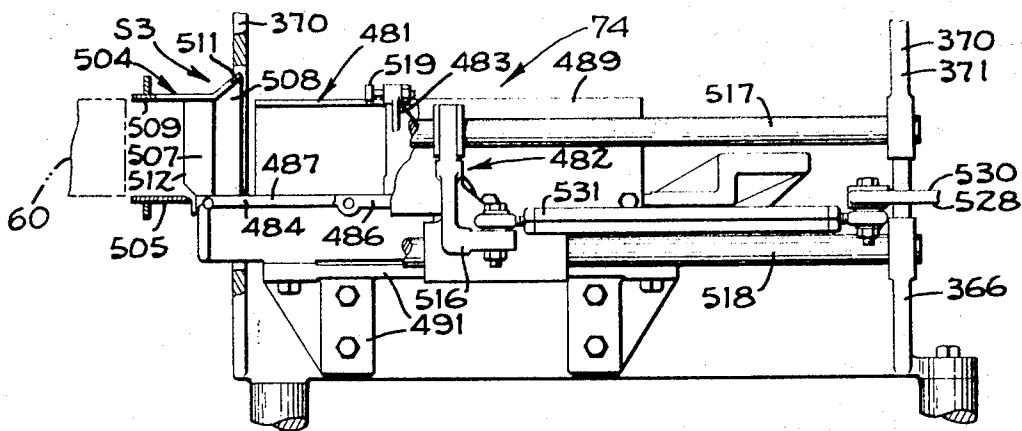
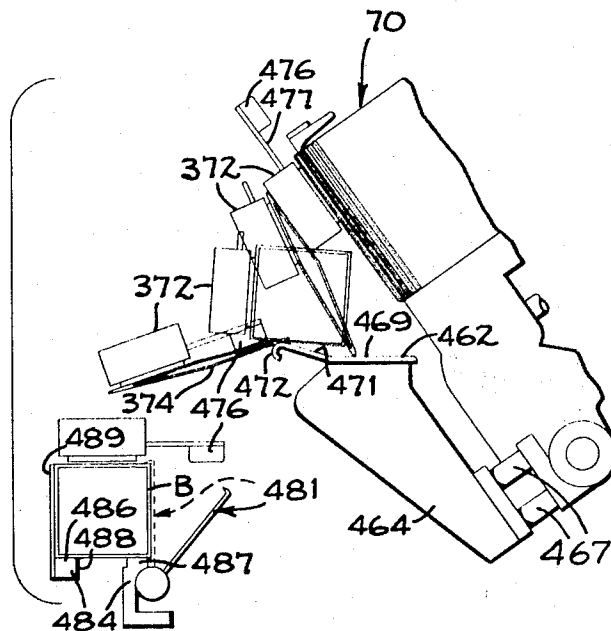


FIG 40

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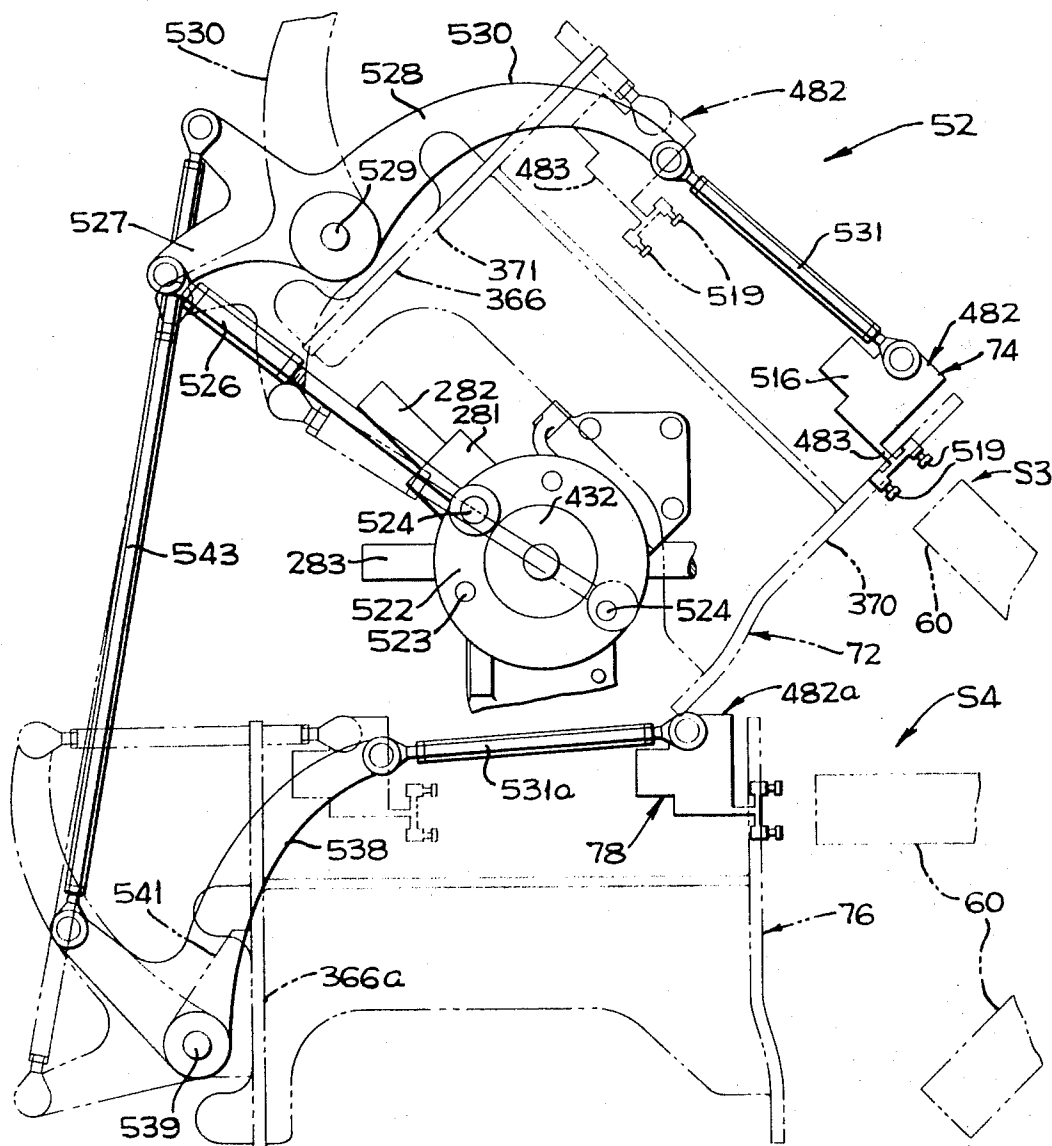


FIG 42

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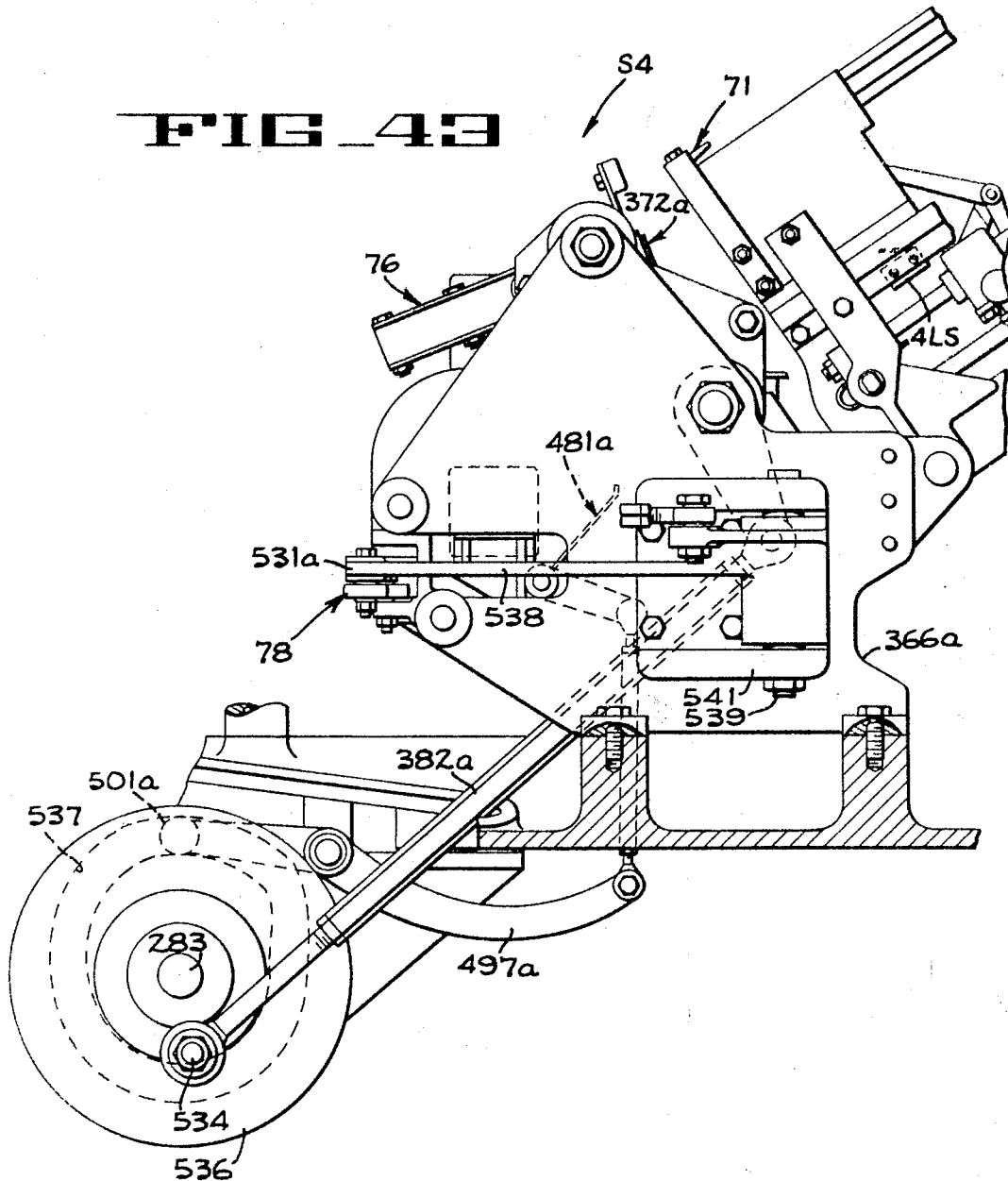
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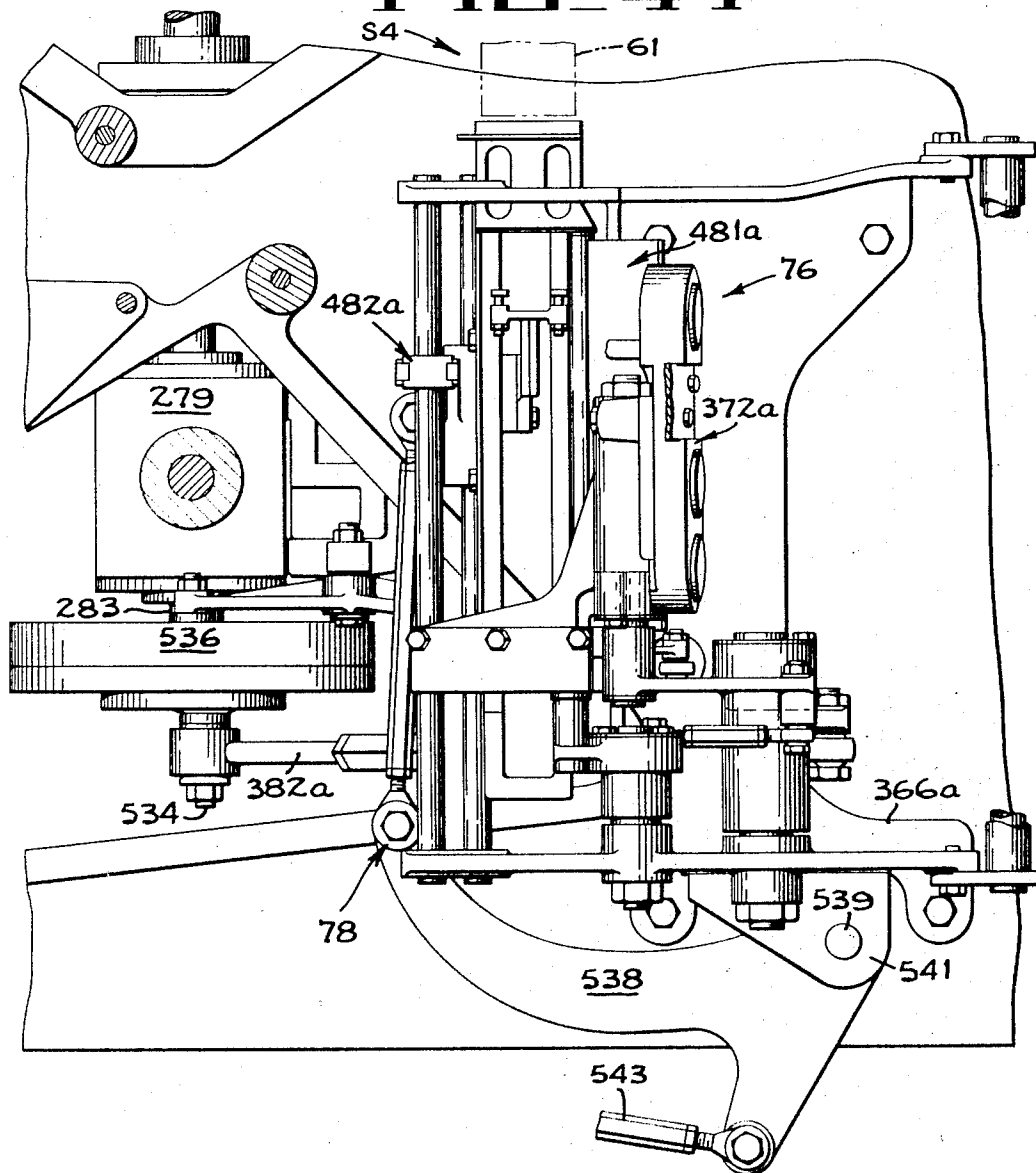
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FIG 44



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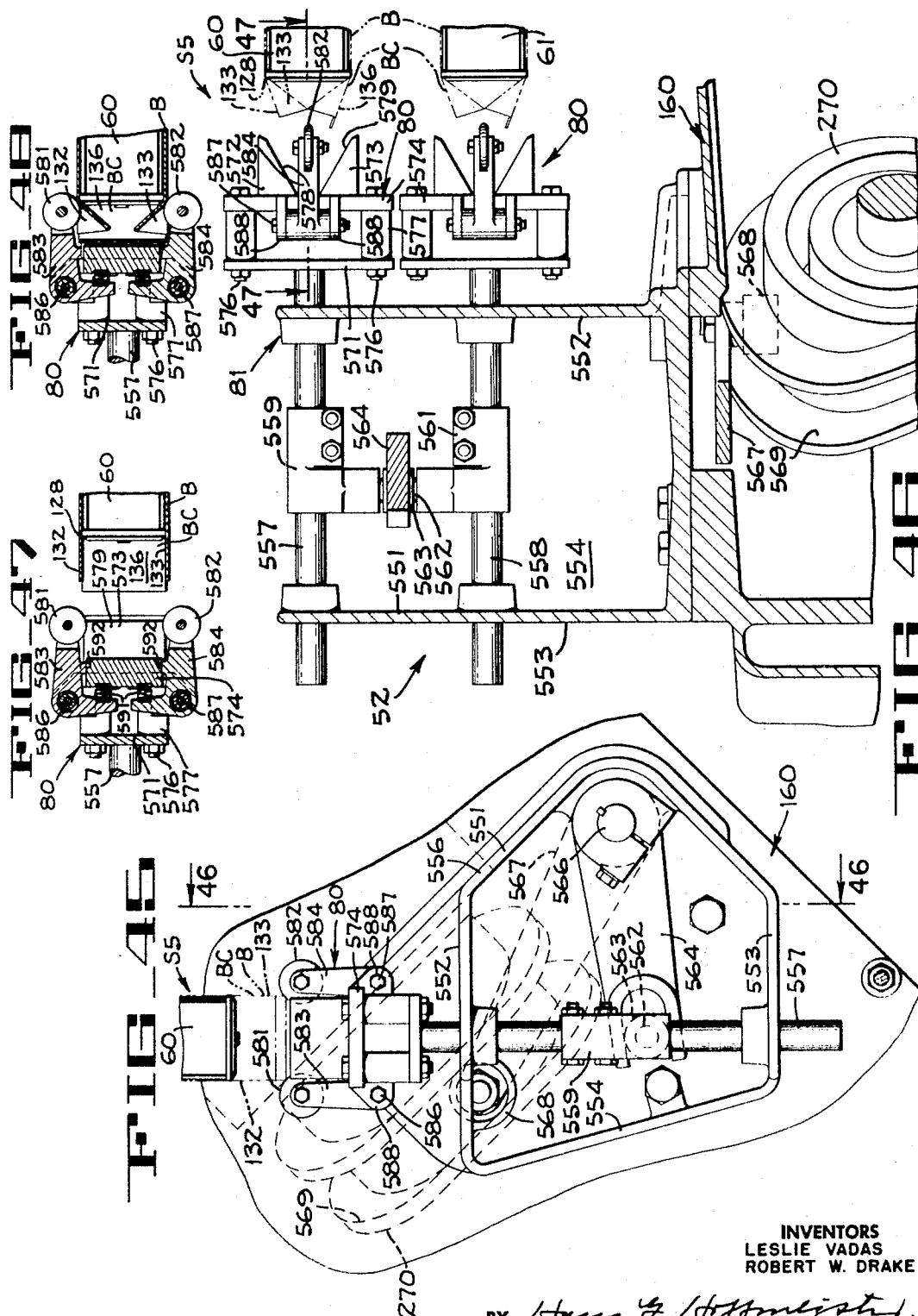
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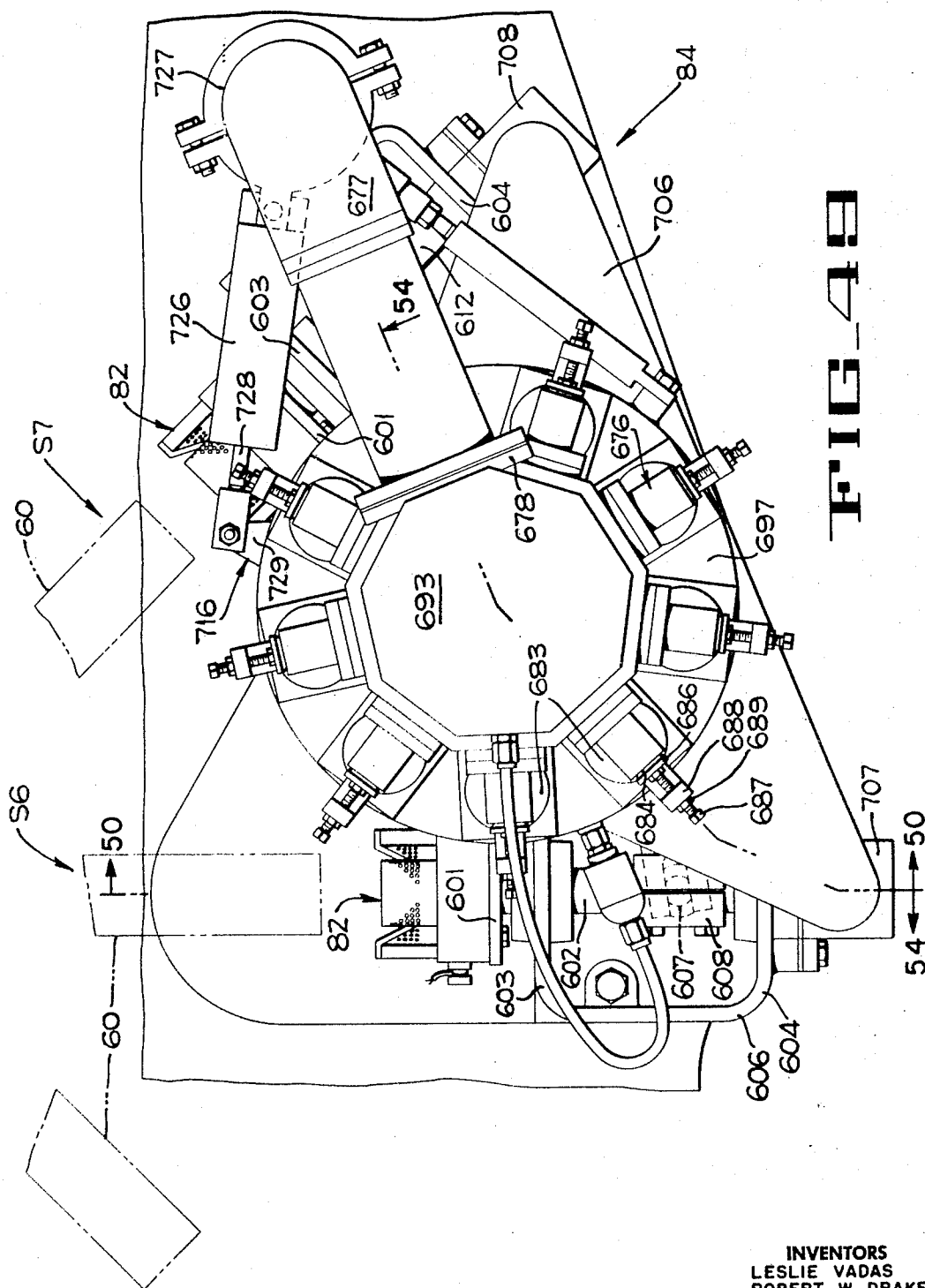


FIG. 49

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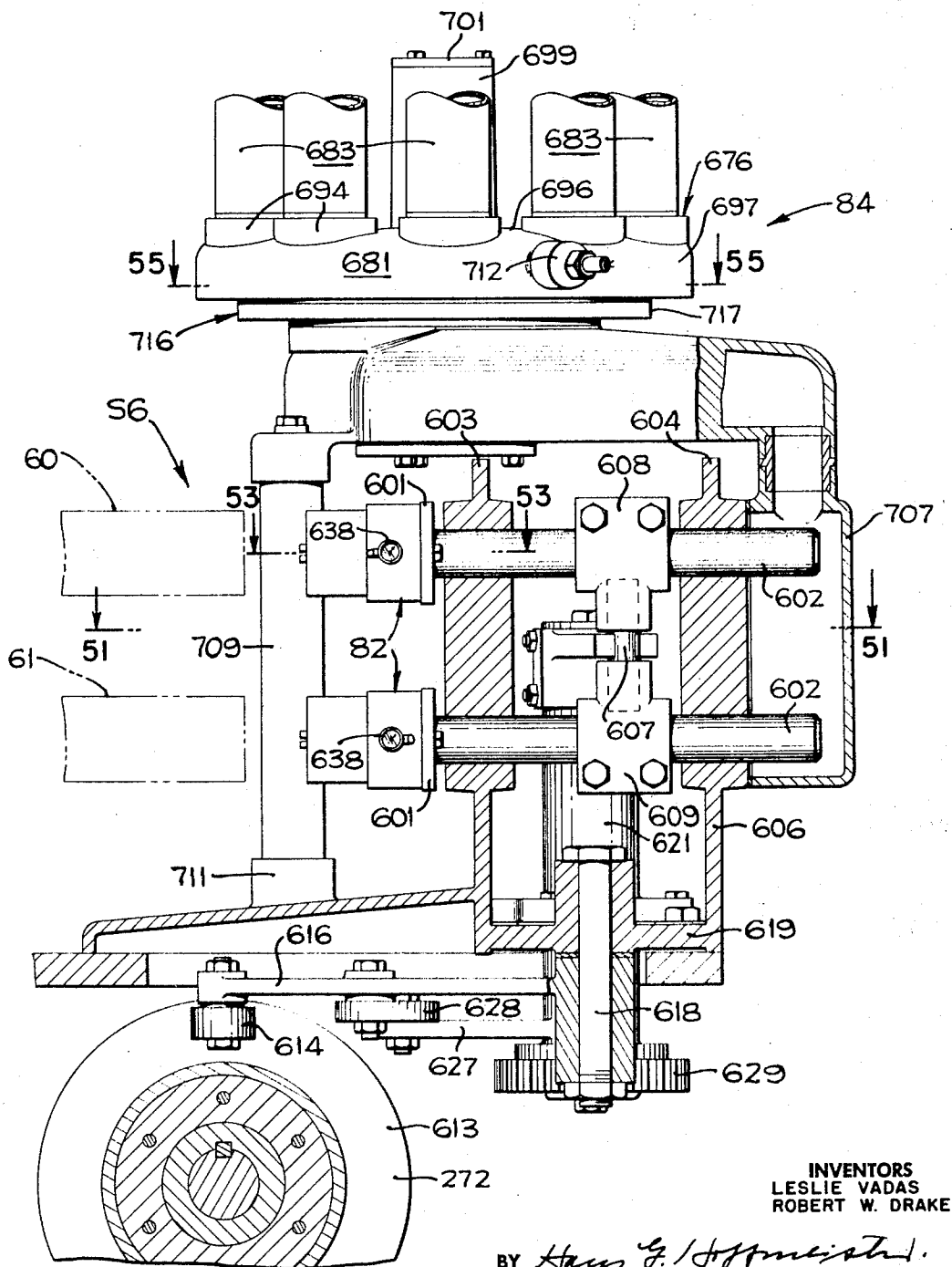
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FIG. 50



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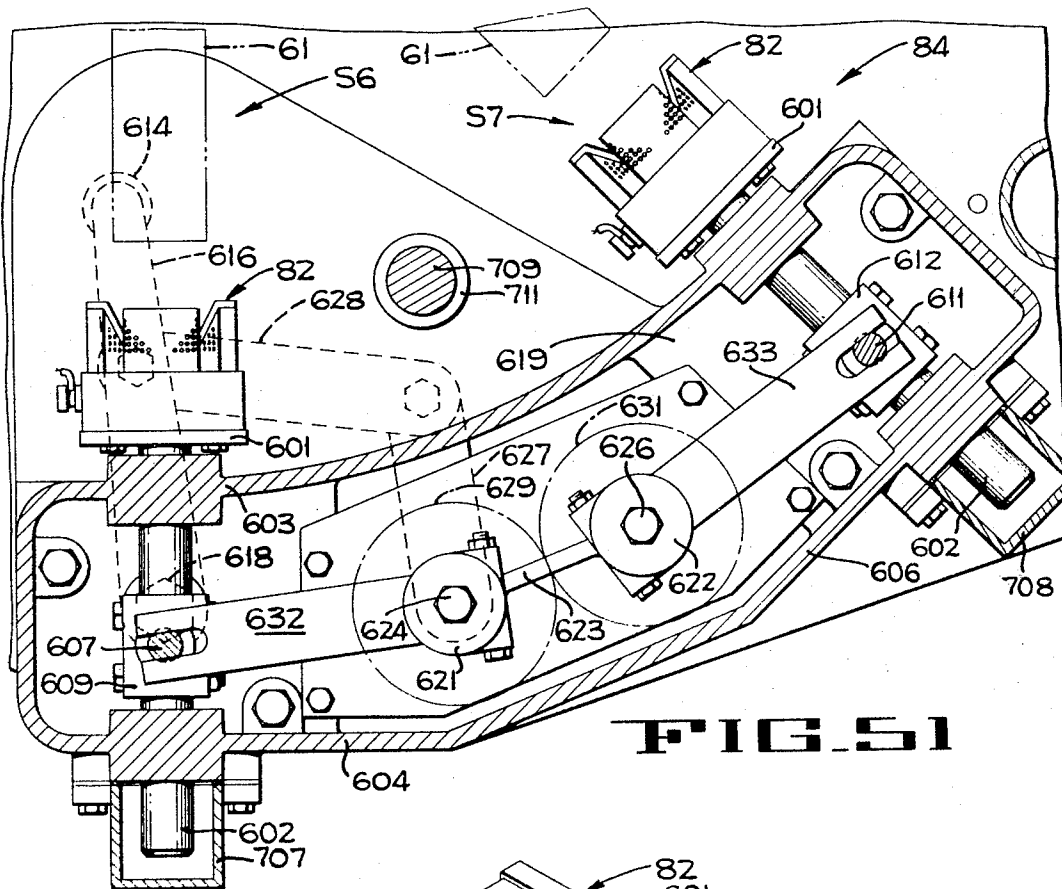


FIG. 51

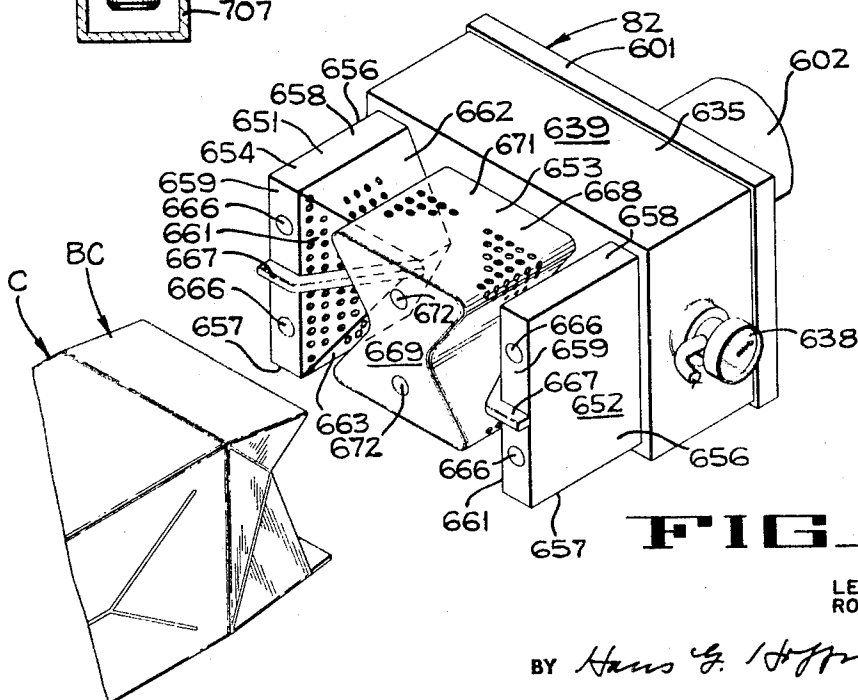


FIG. 52

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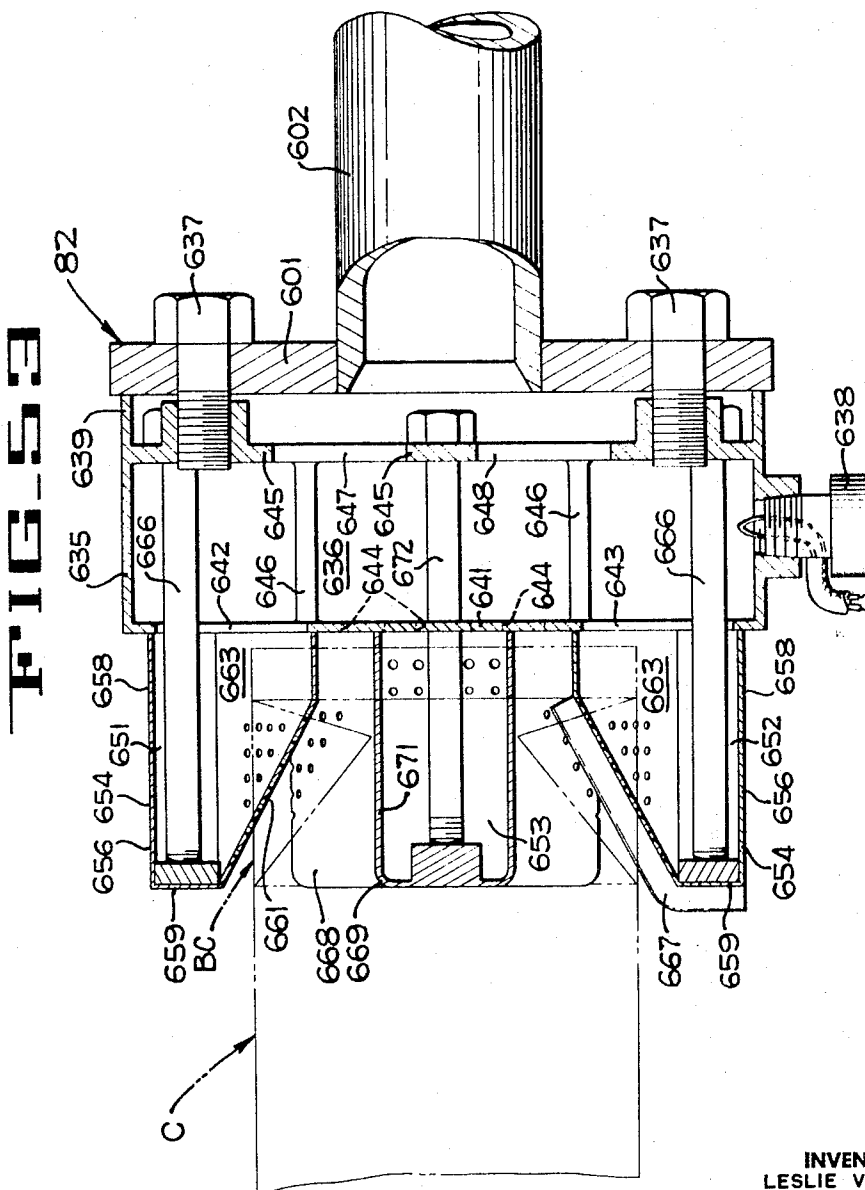
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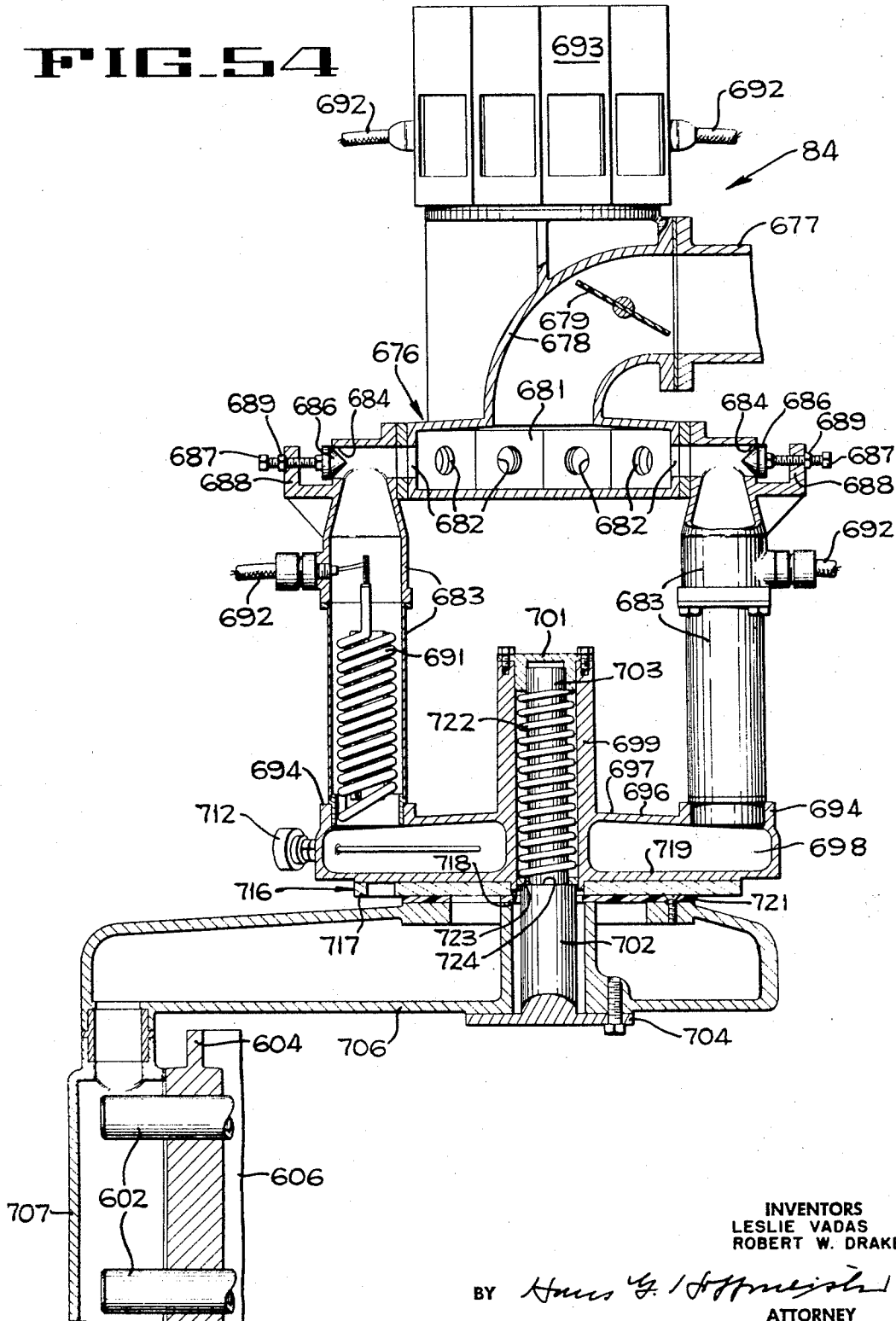
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FIG. 54



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FIG. 55

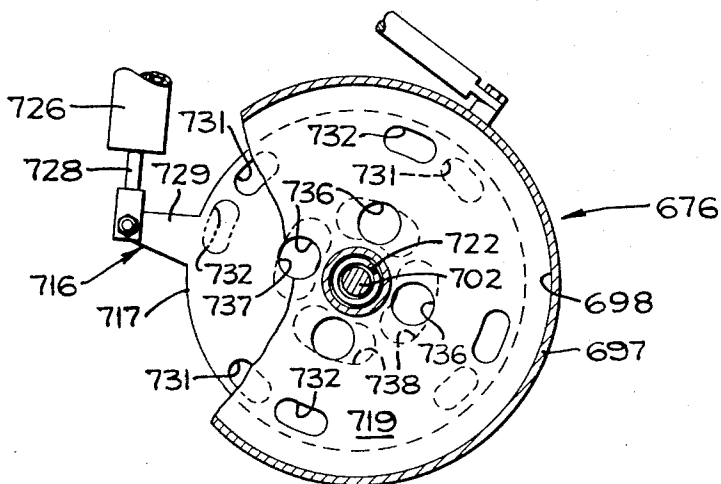
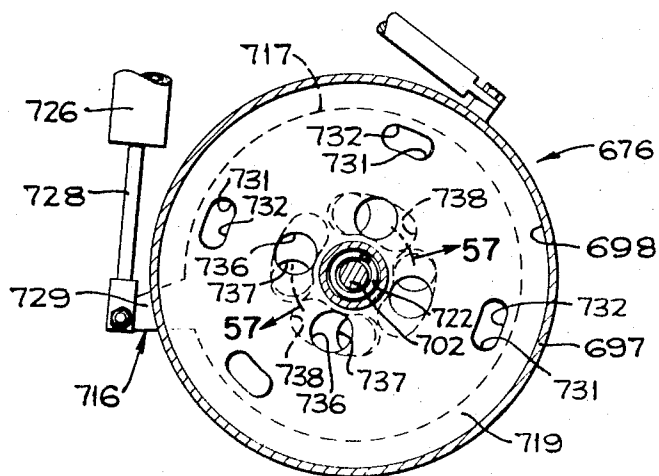


FIG. 56

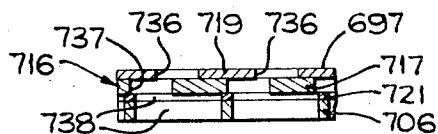


FIG. 57

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FIG-62

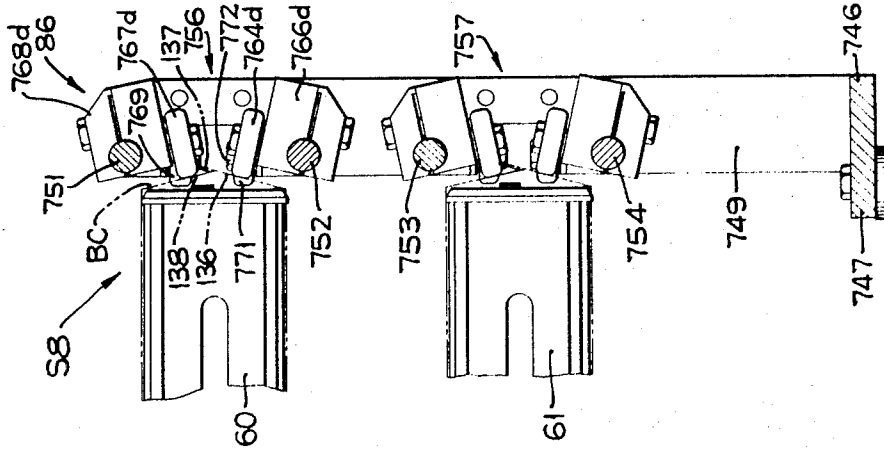


FIG-61

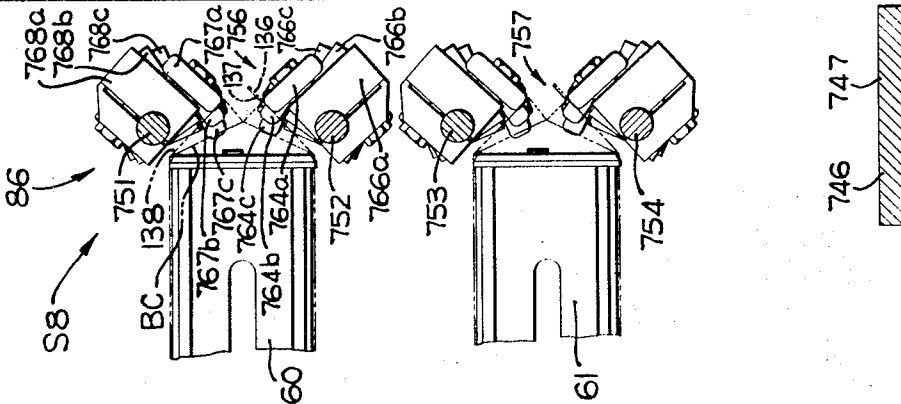
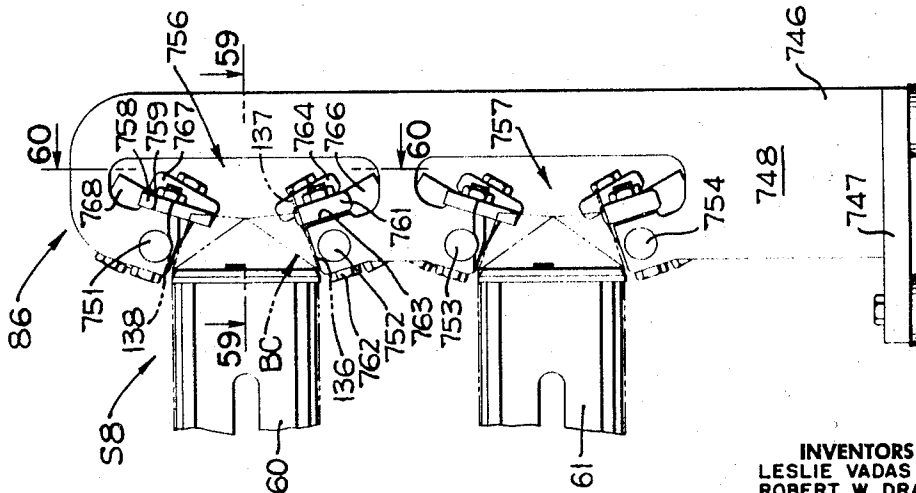


FIG-58



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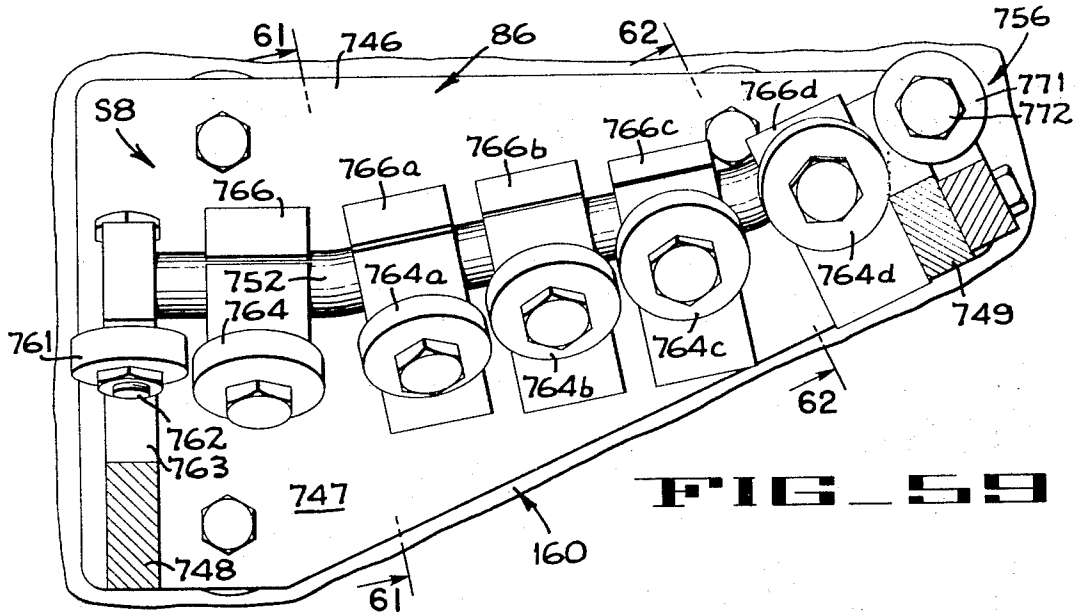
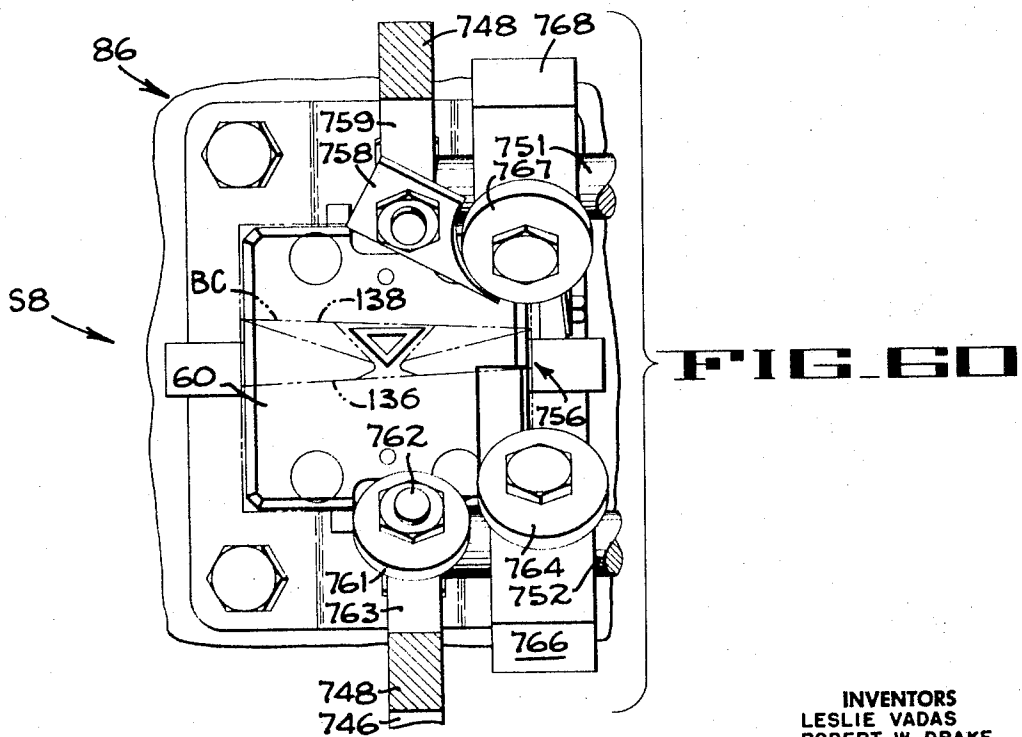
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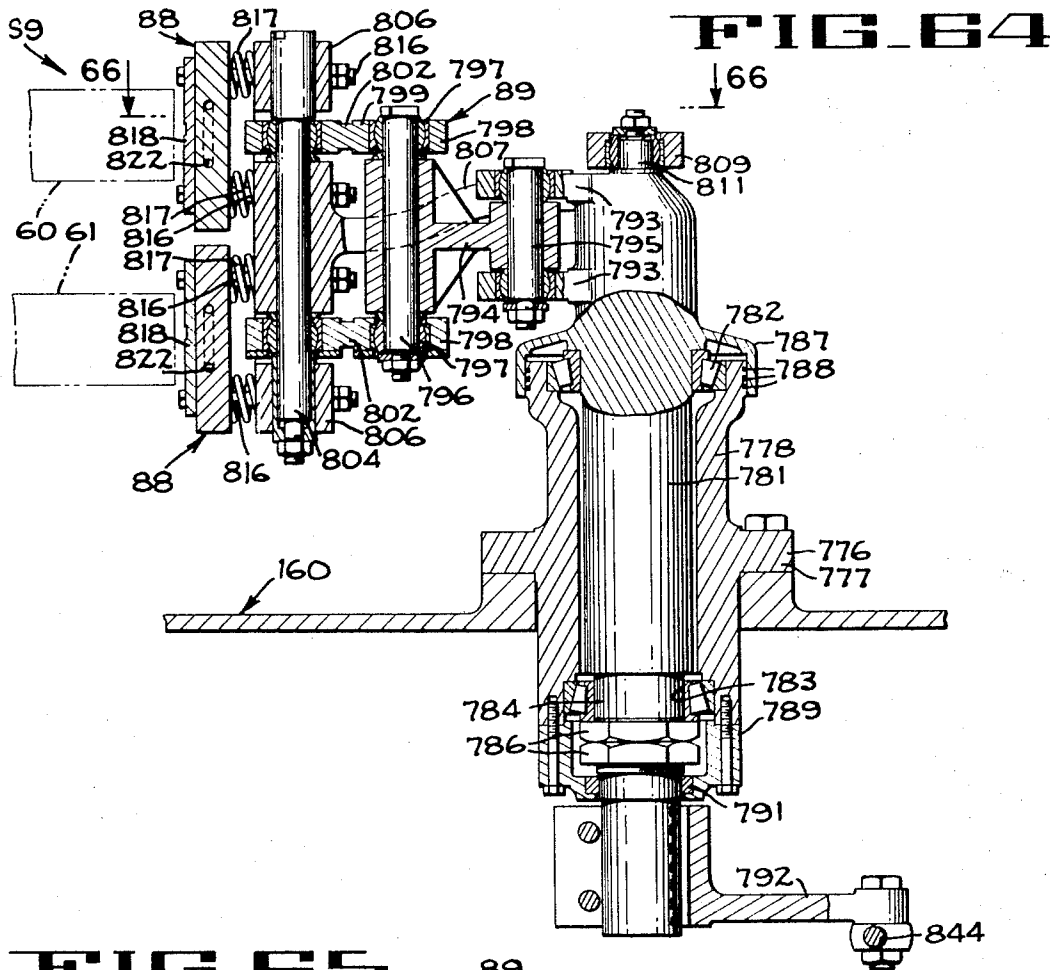
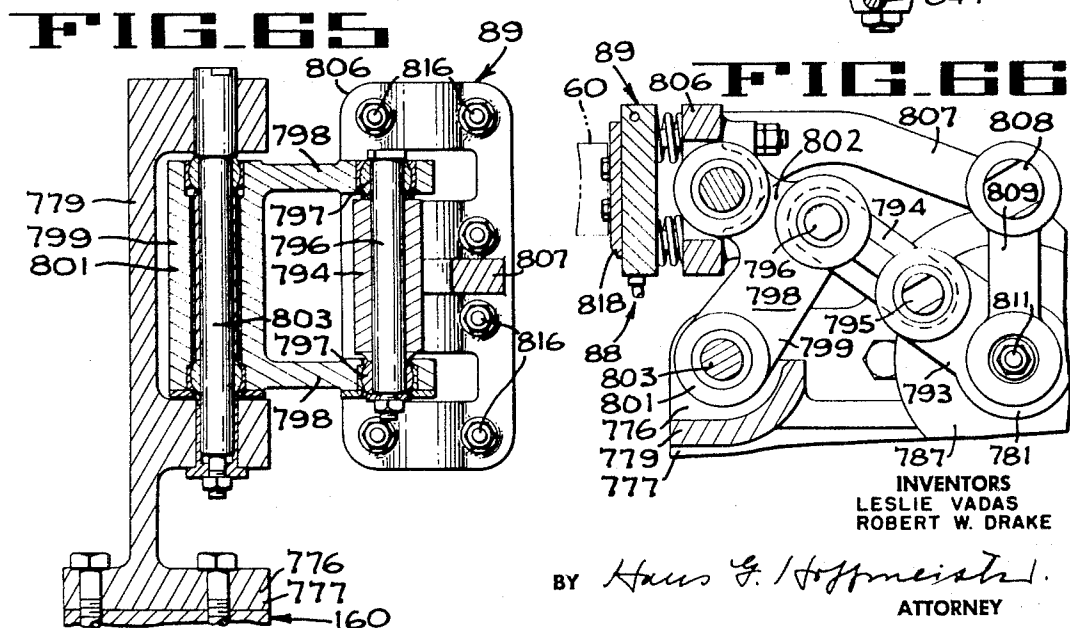
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FIG. 67

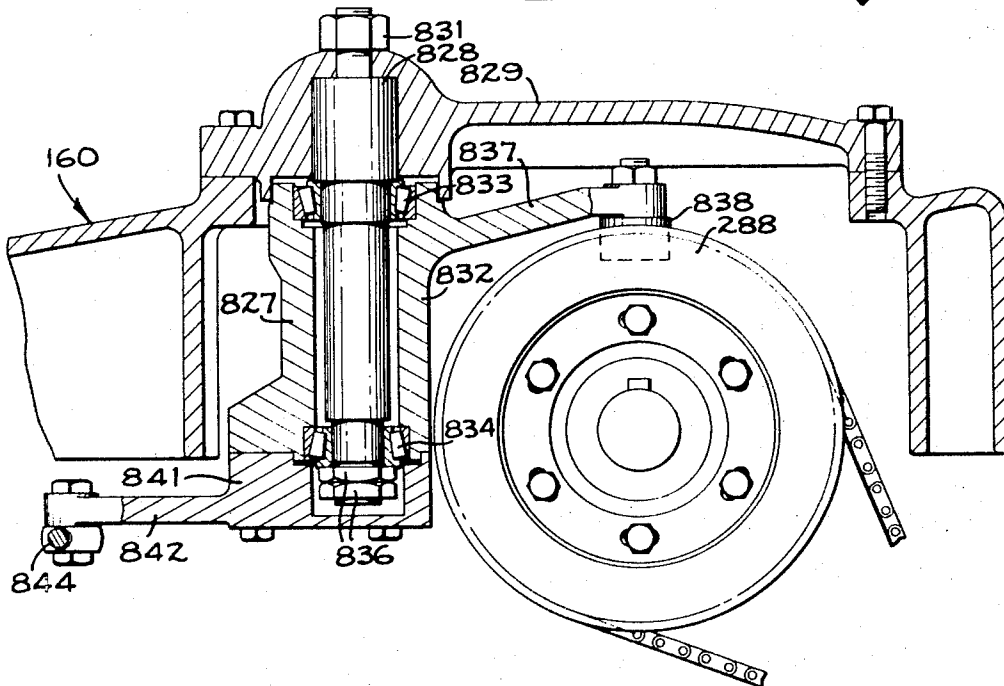


FIG. 68

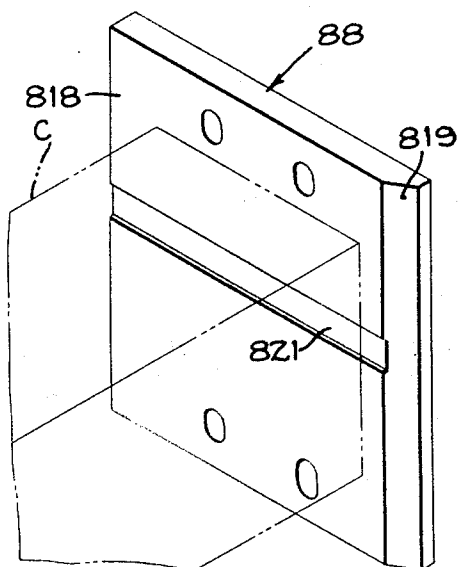
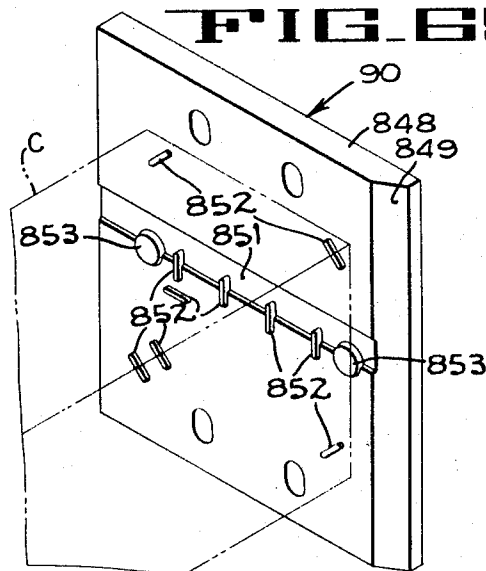


FIG. 69



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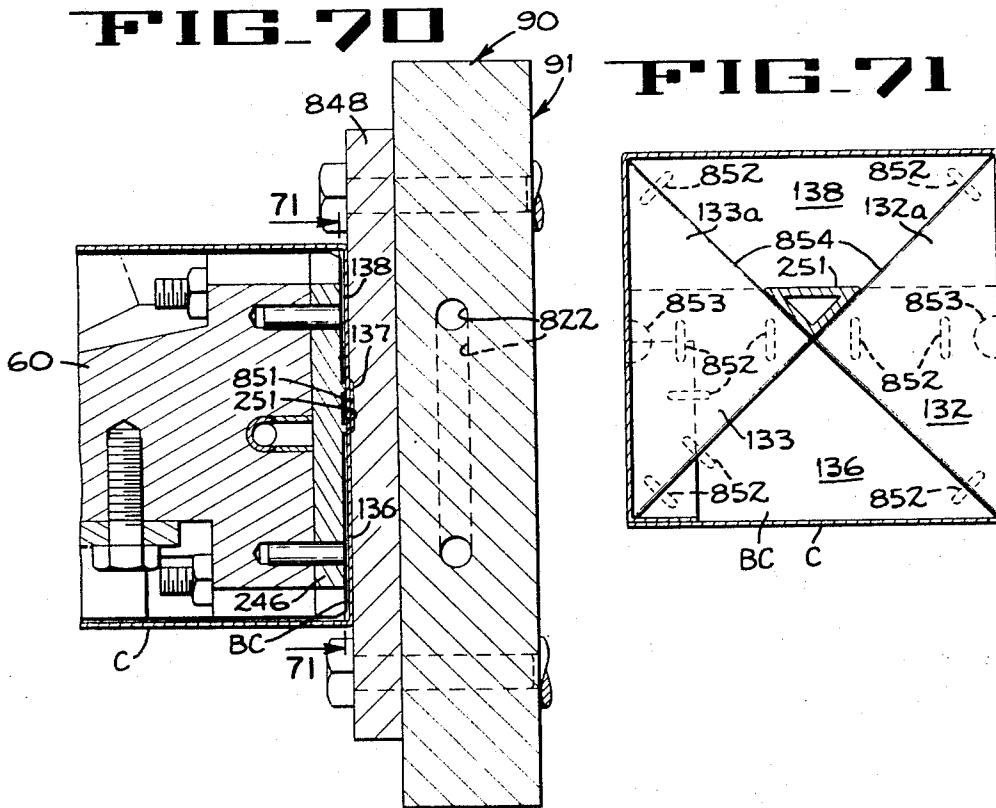
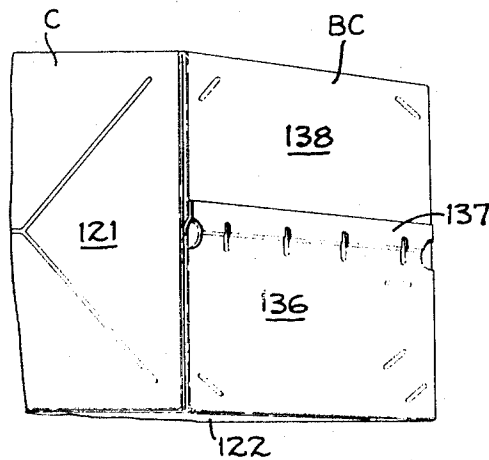
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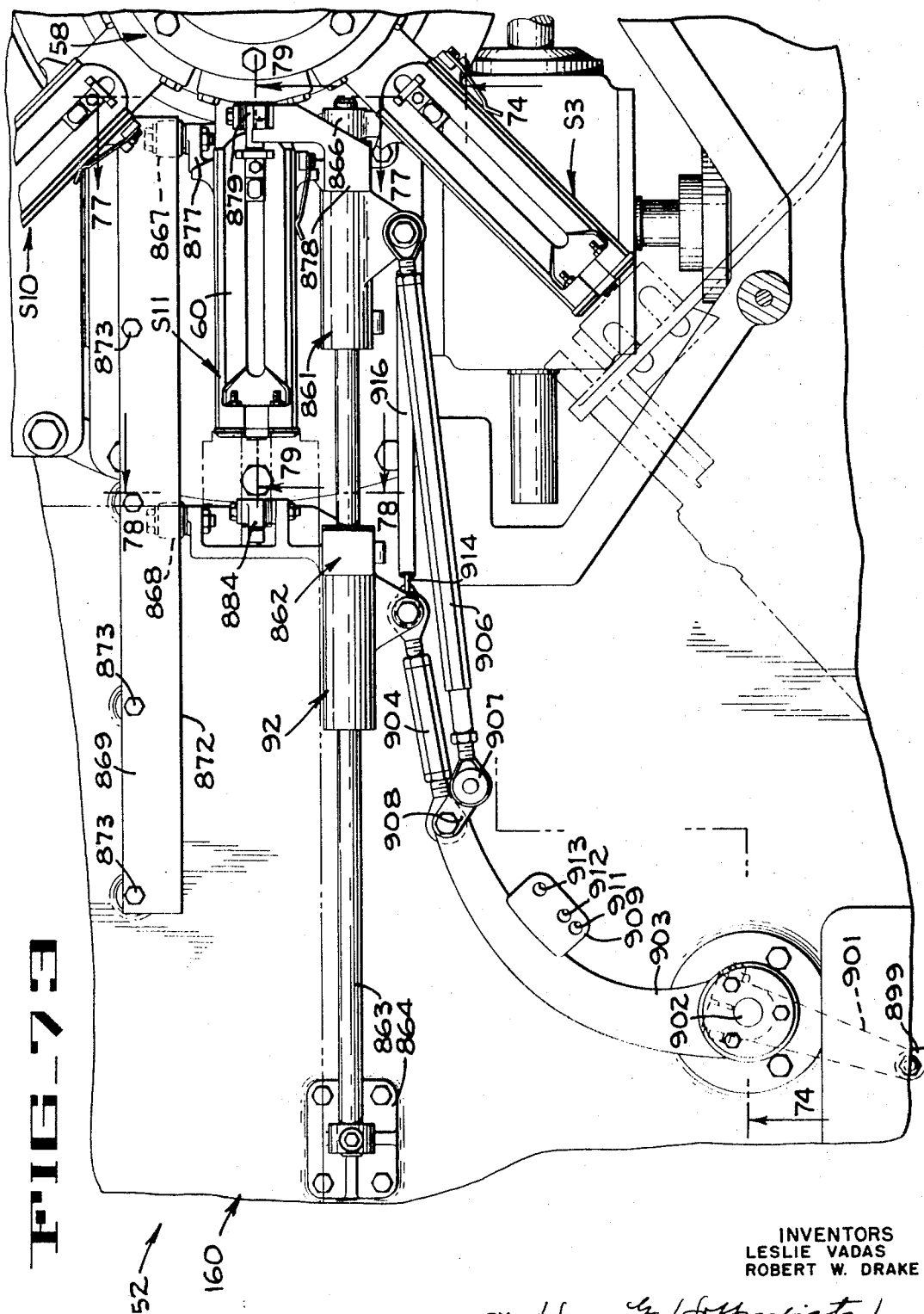
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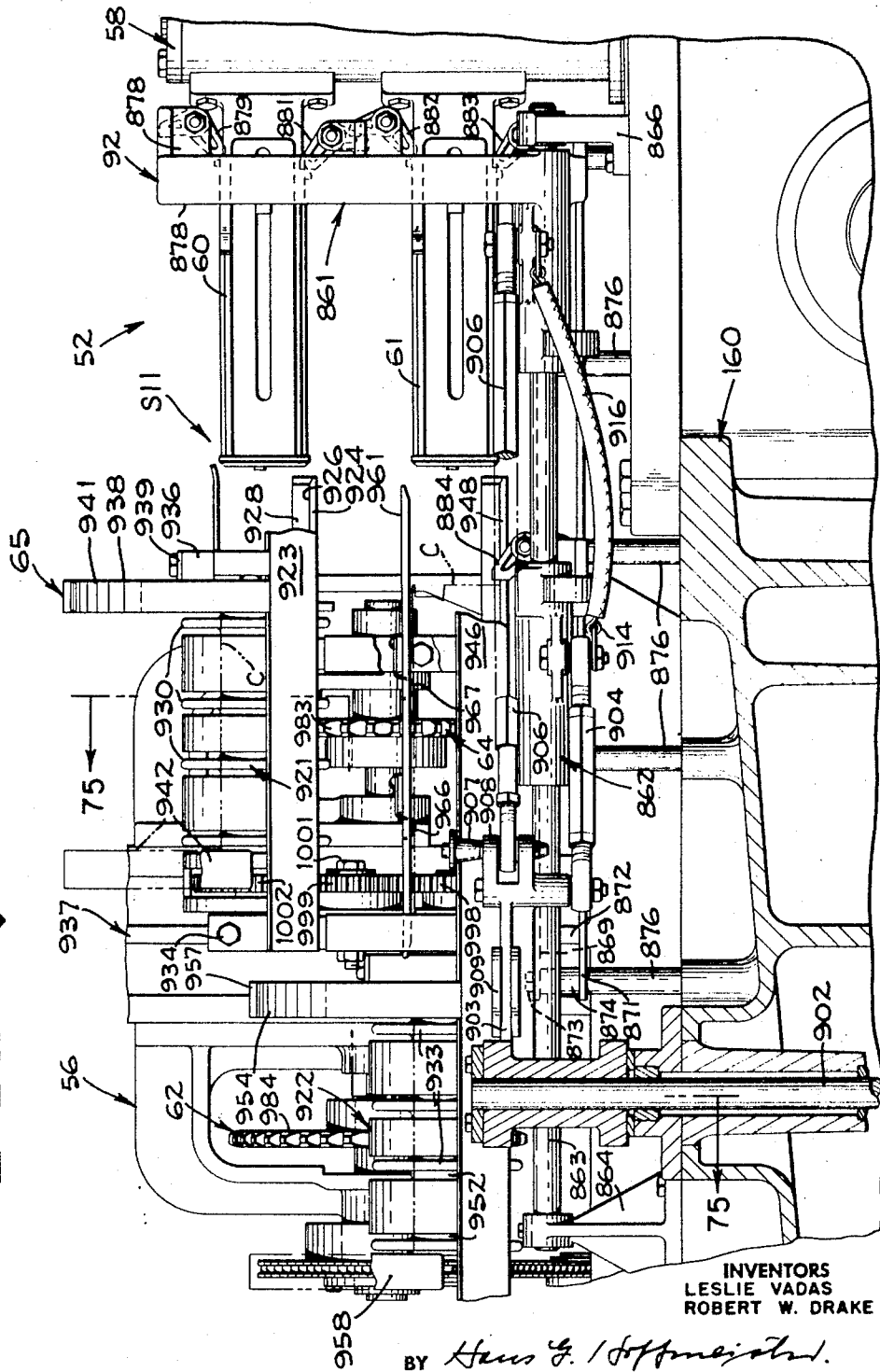
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FIG-74



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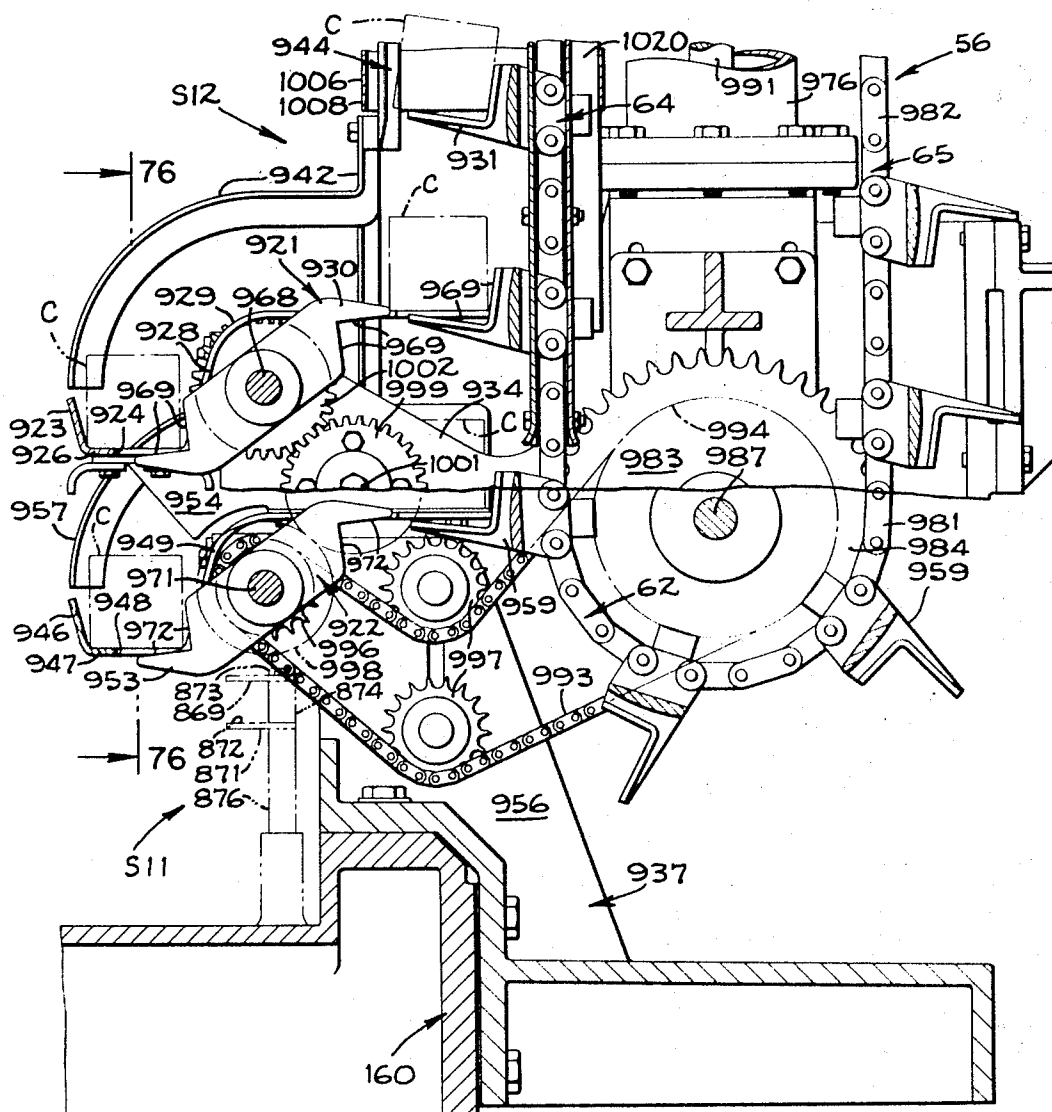


FIG. 75.

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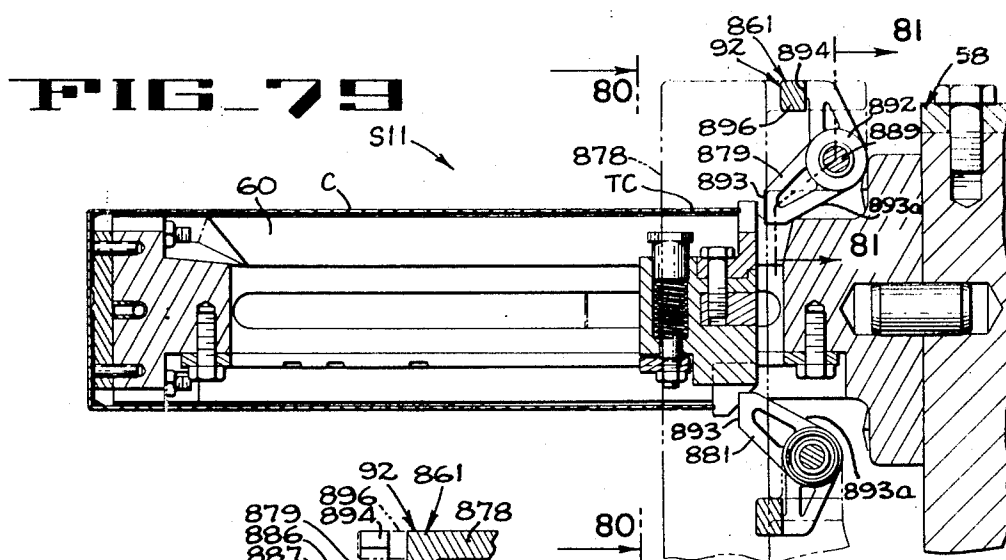
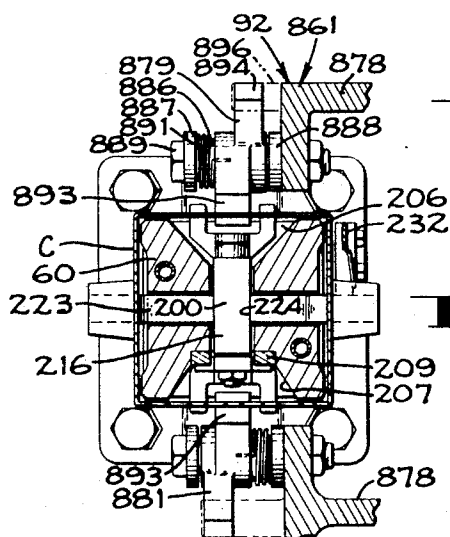


FIG 80

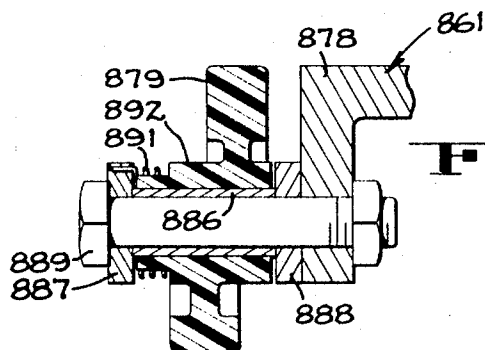


FIG 81

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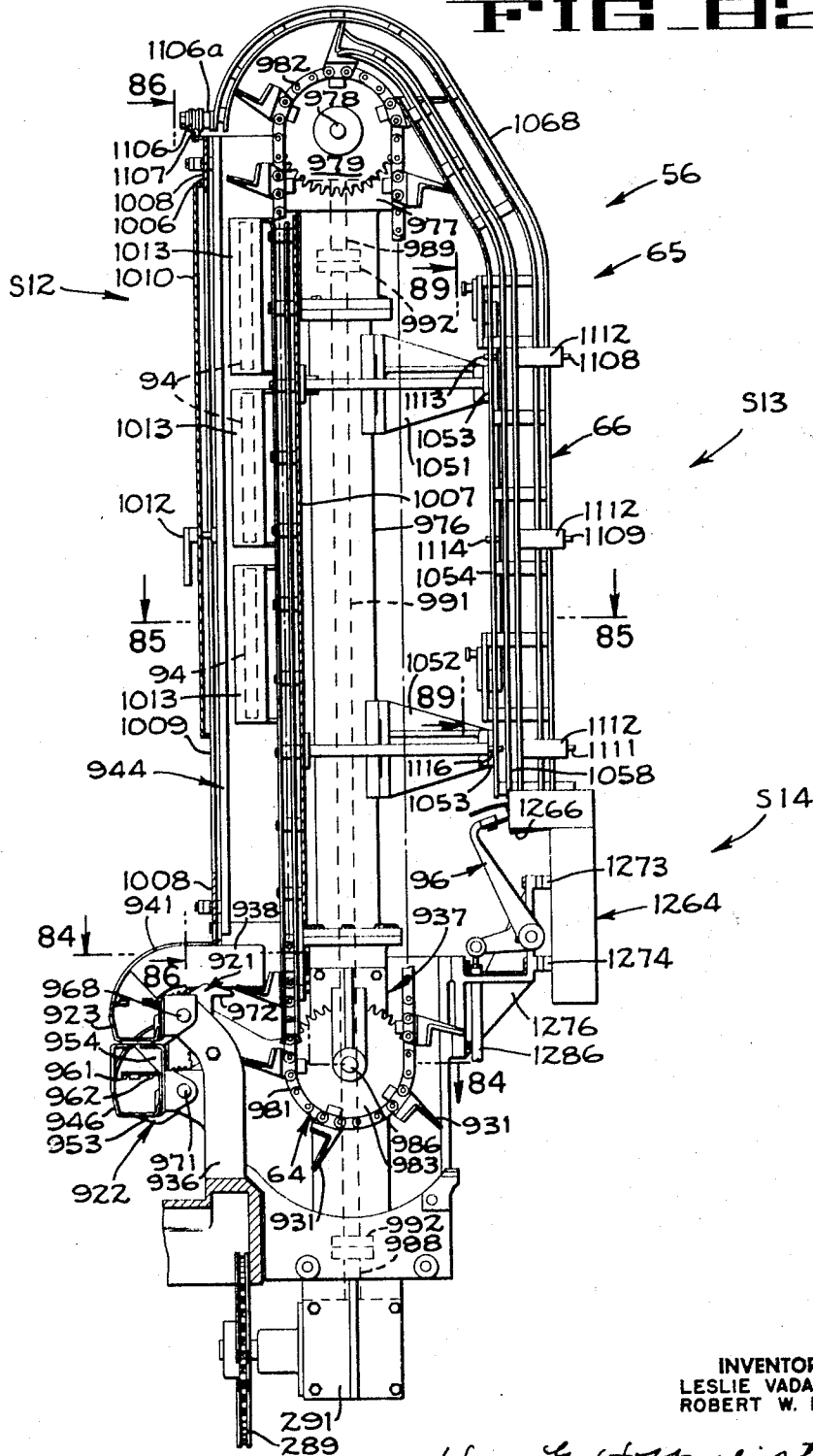
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FIG 82



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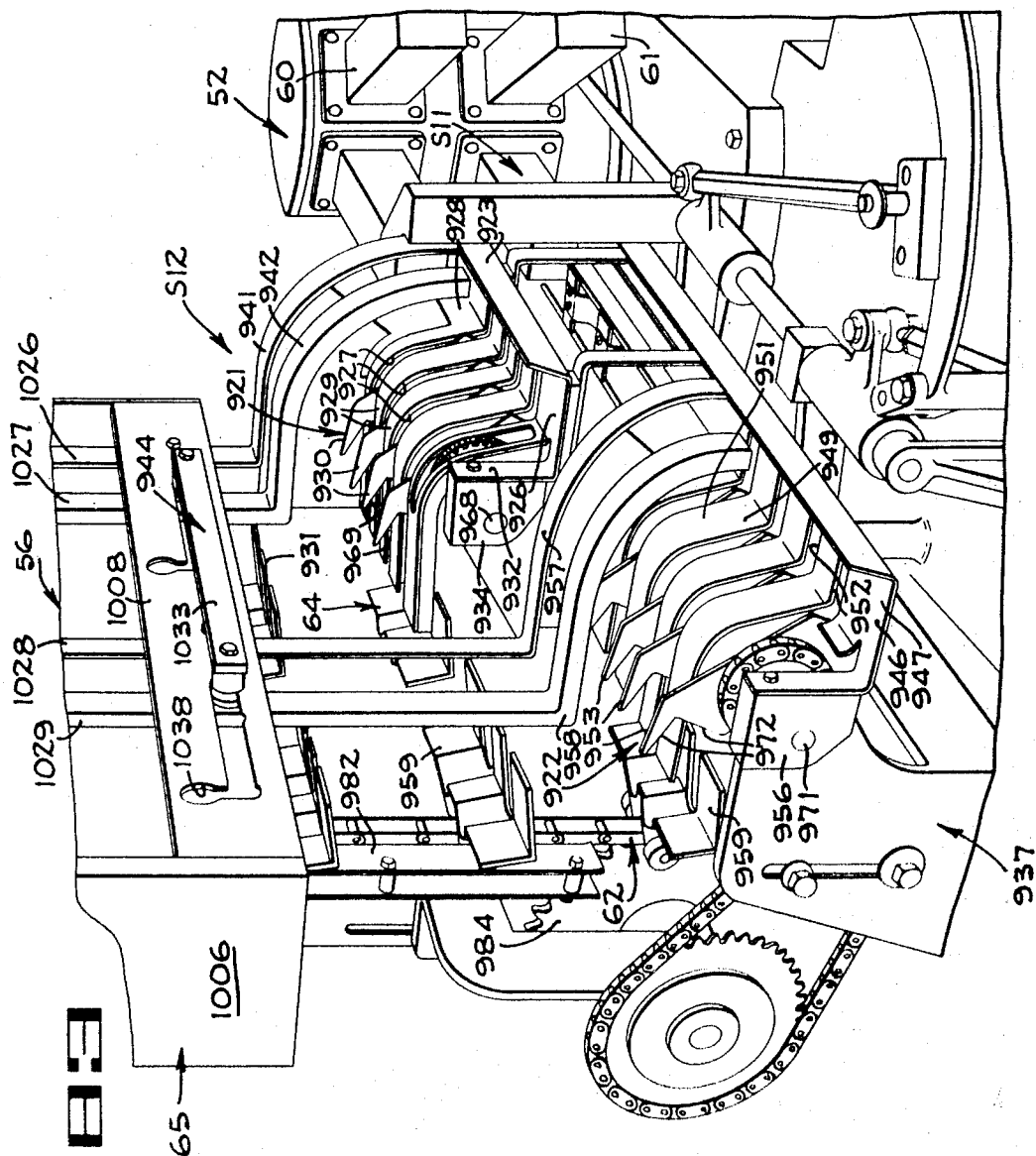


FIG. 42

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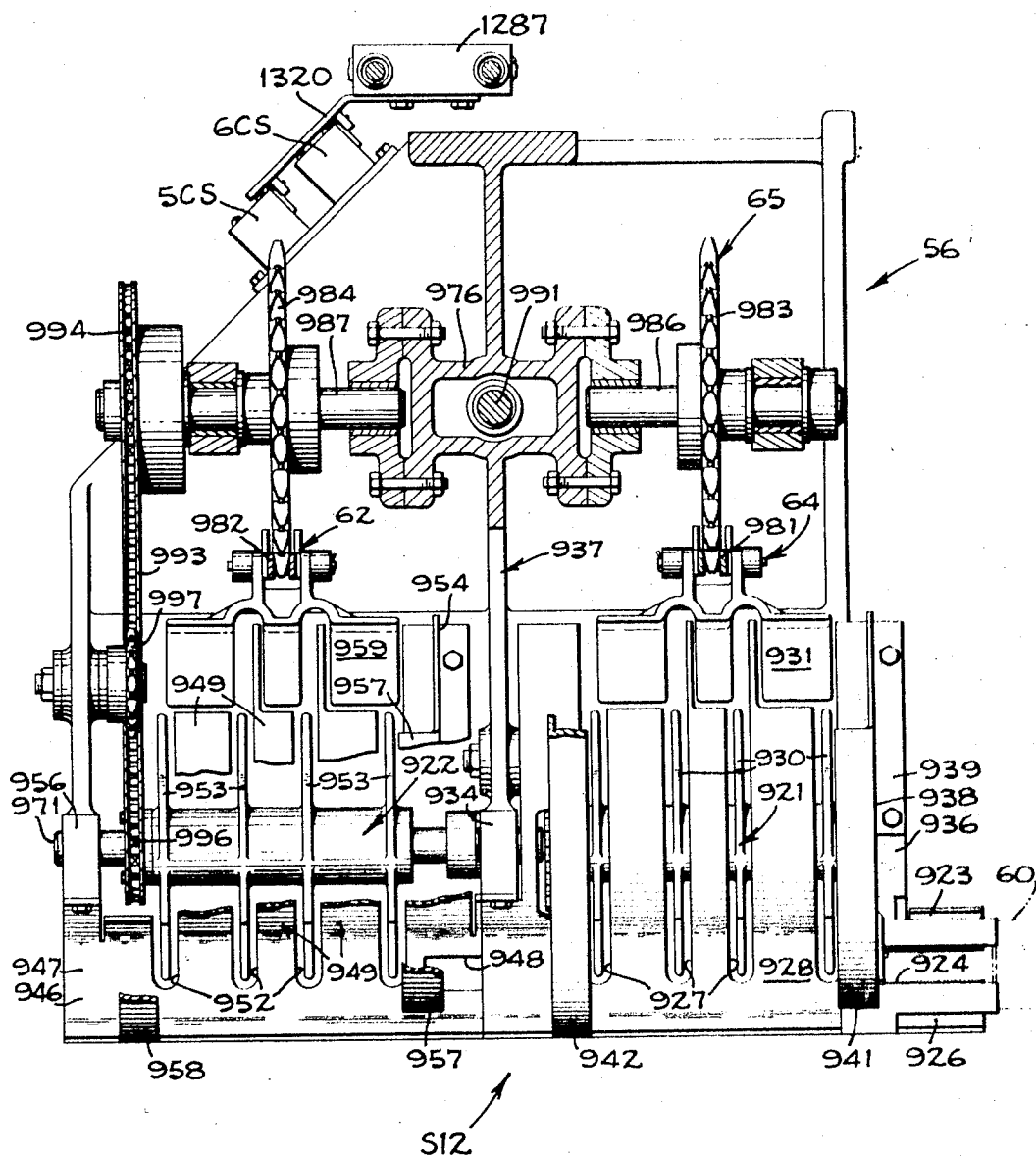
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FIG 84



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[illegible]

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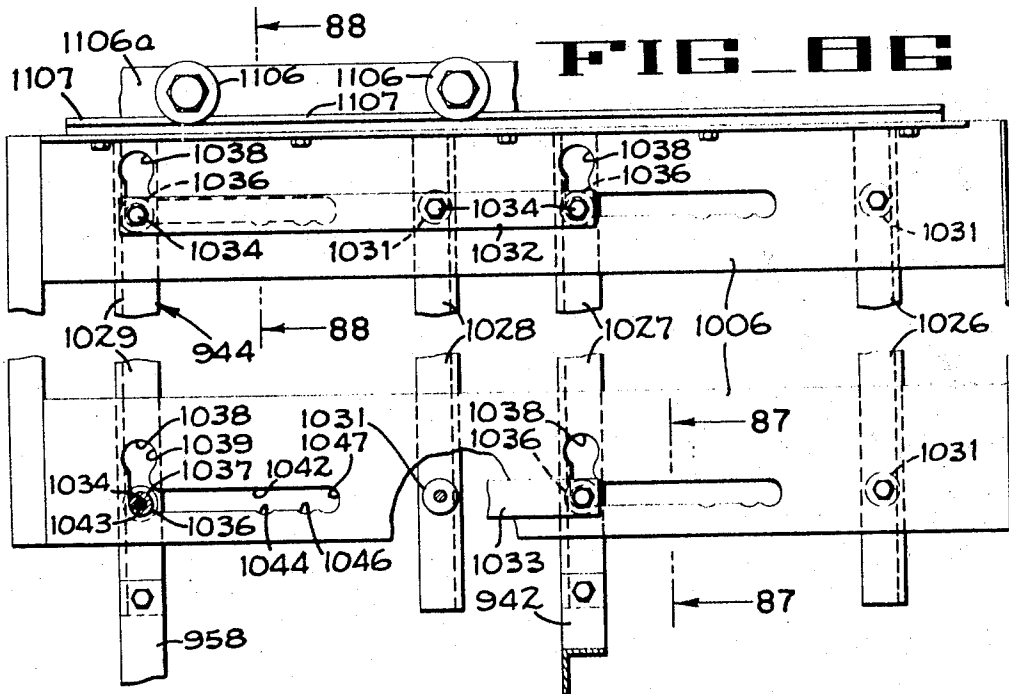
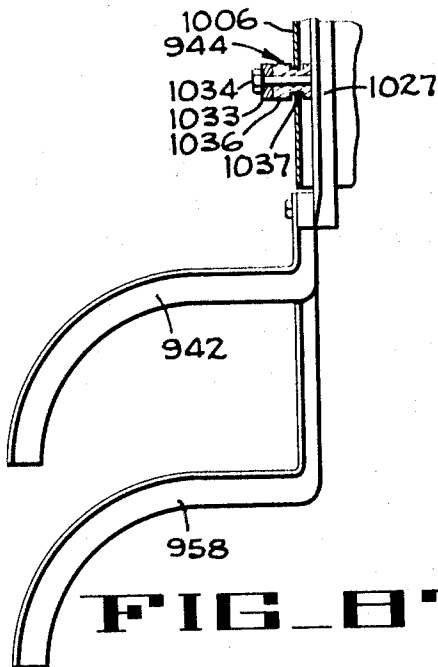
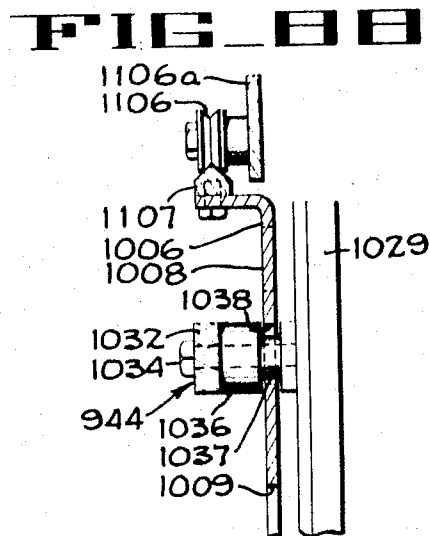
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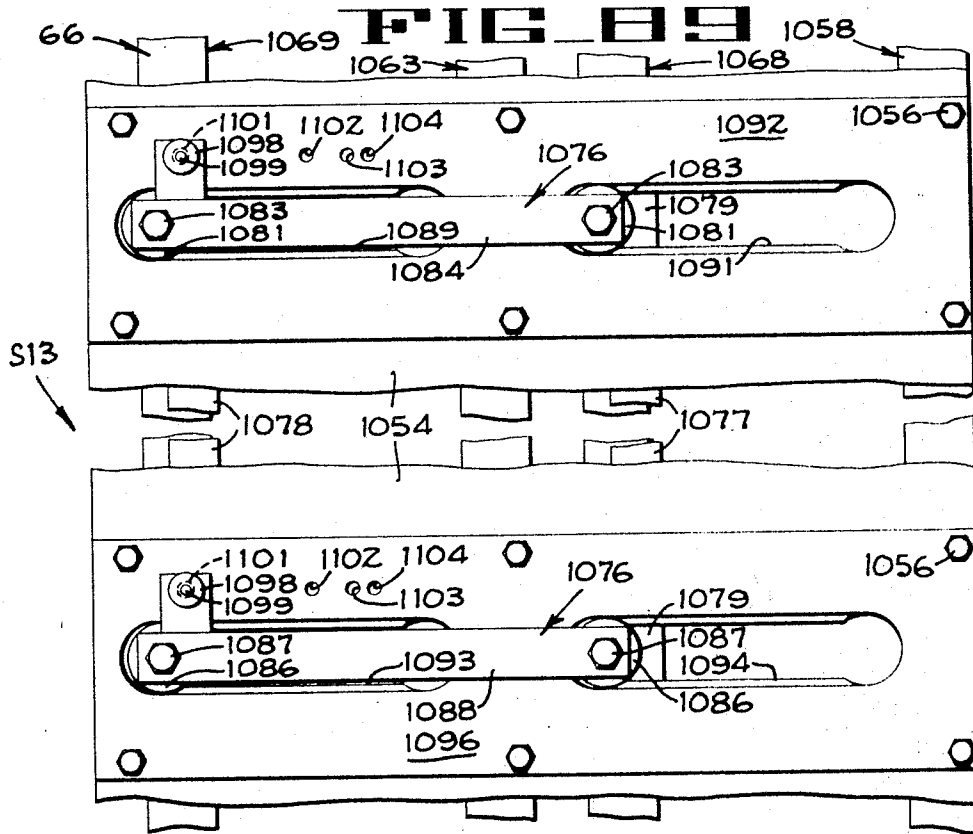
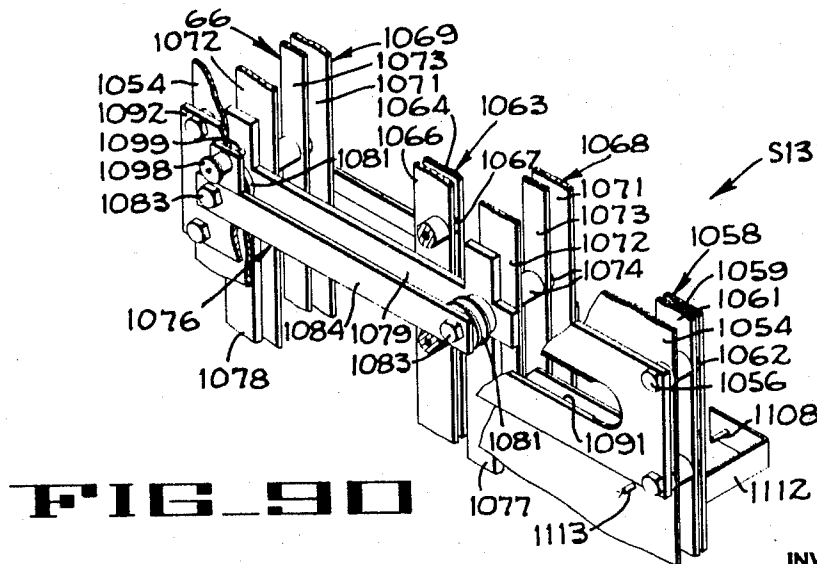
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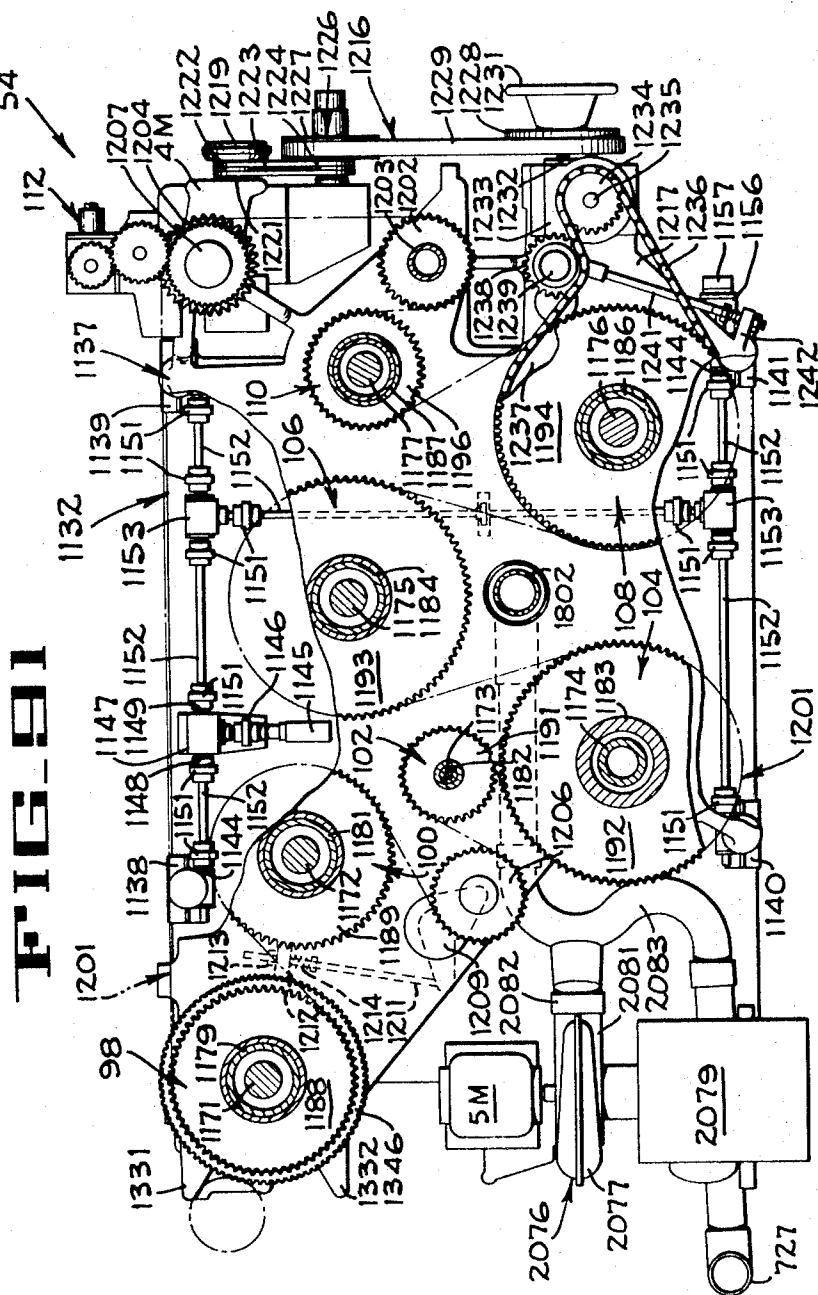
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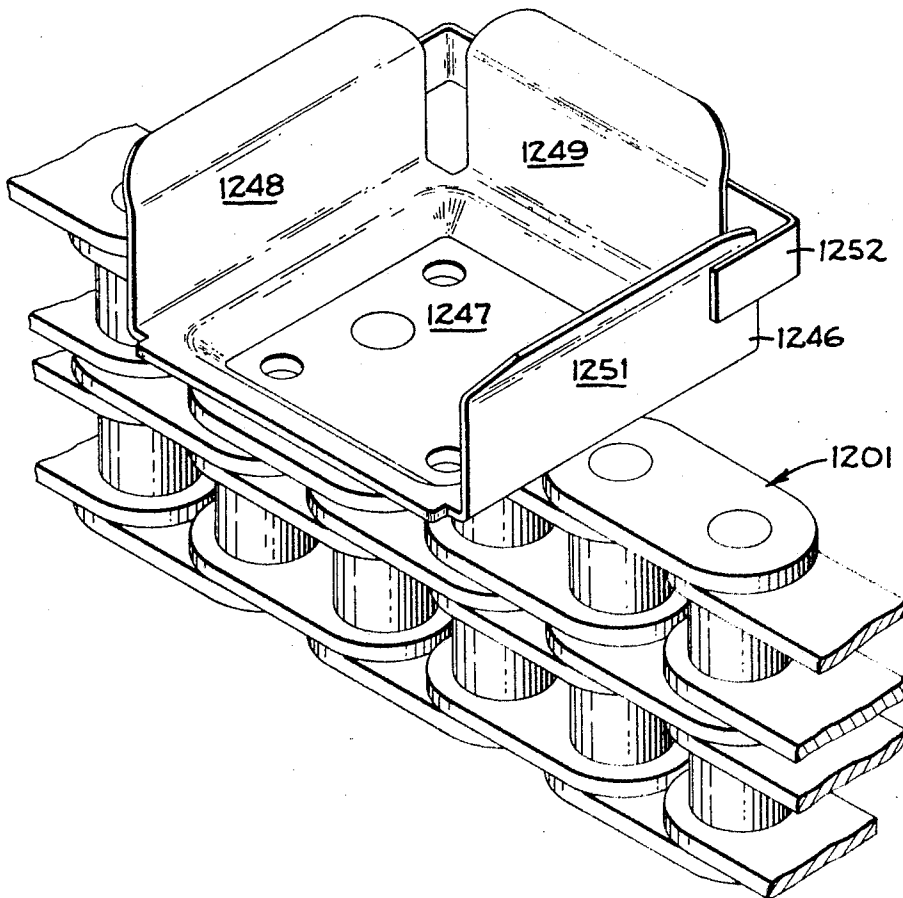
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FIG. 94



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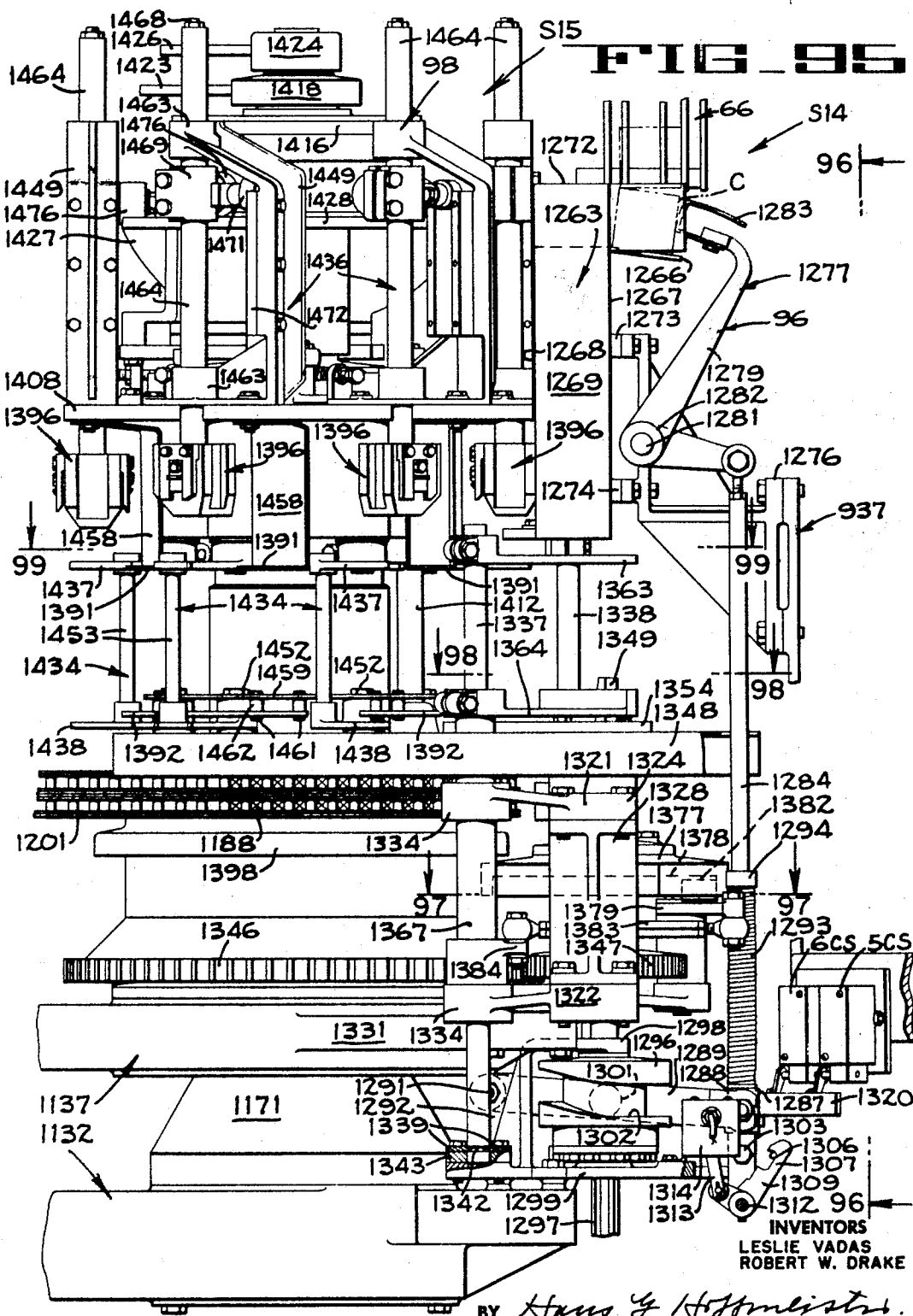
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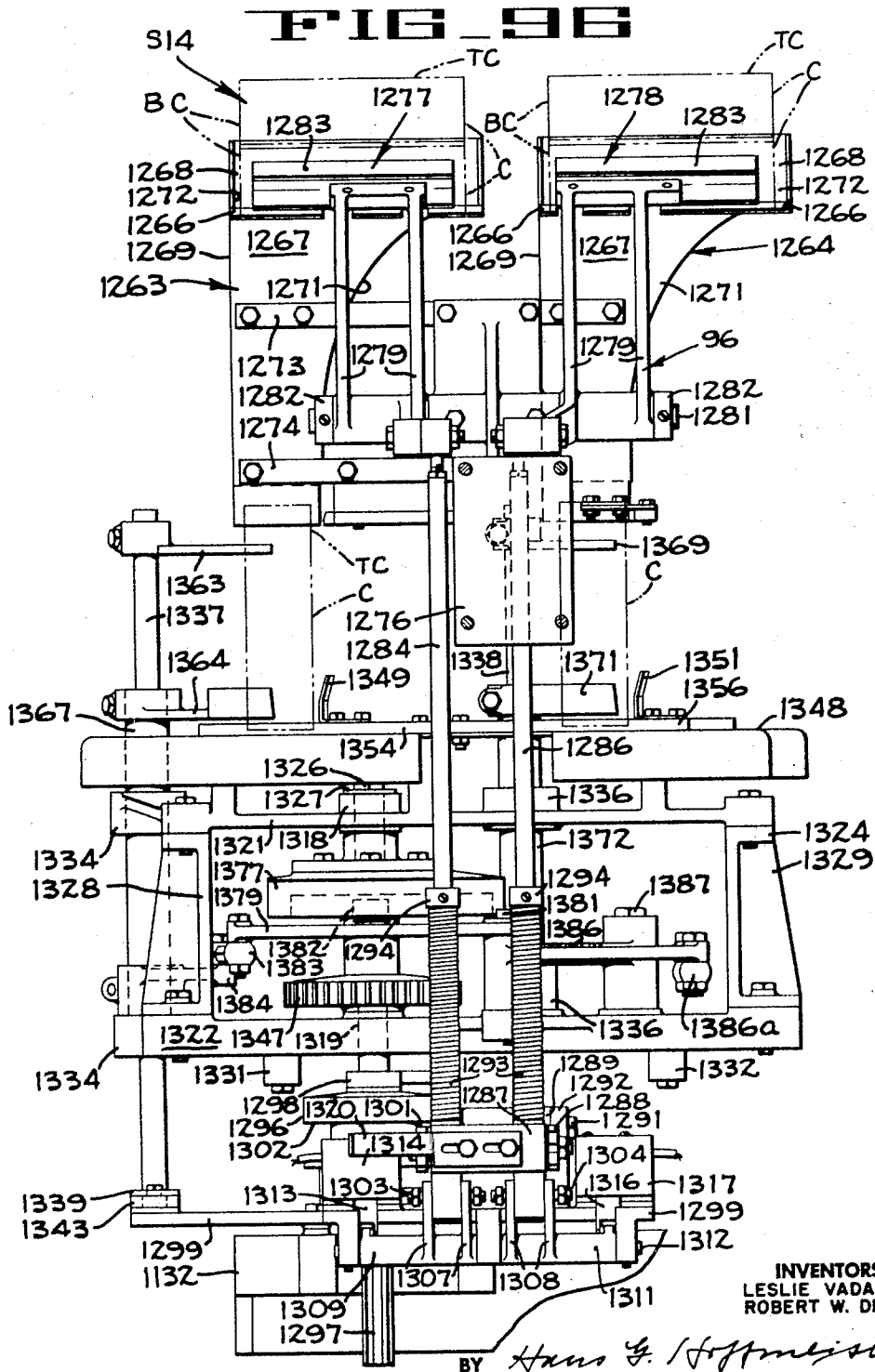
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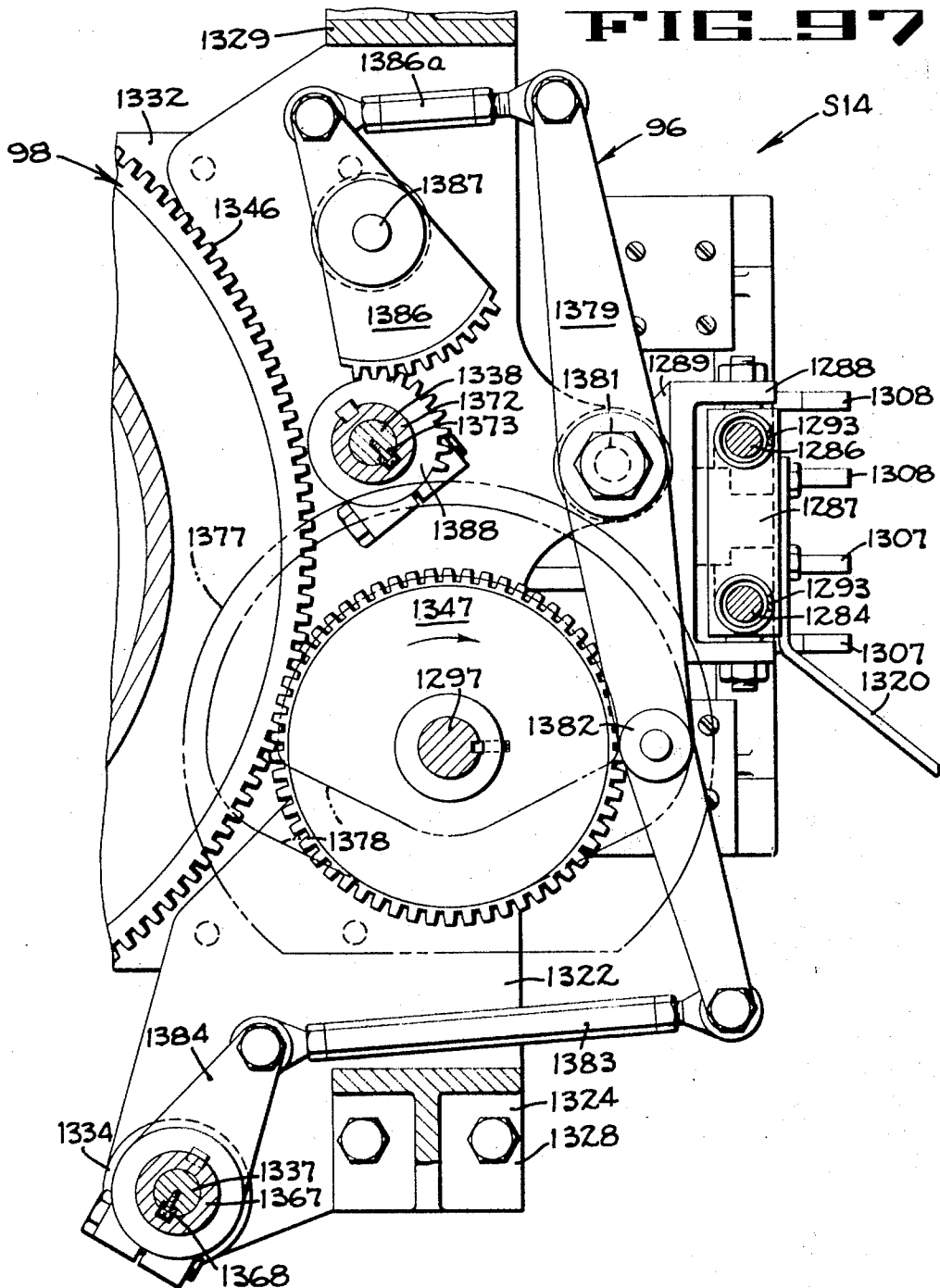
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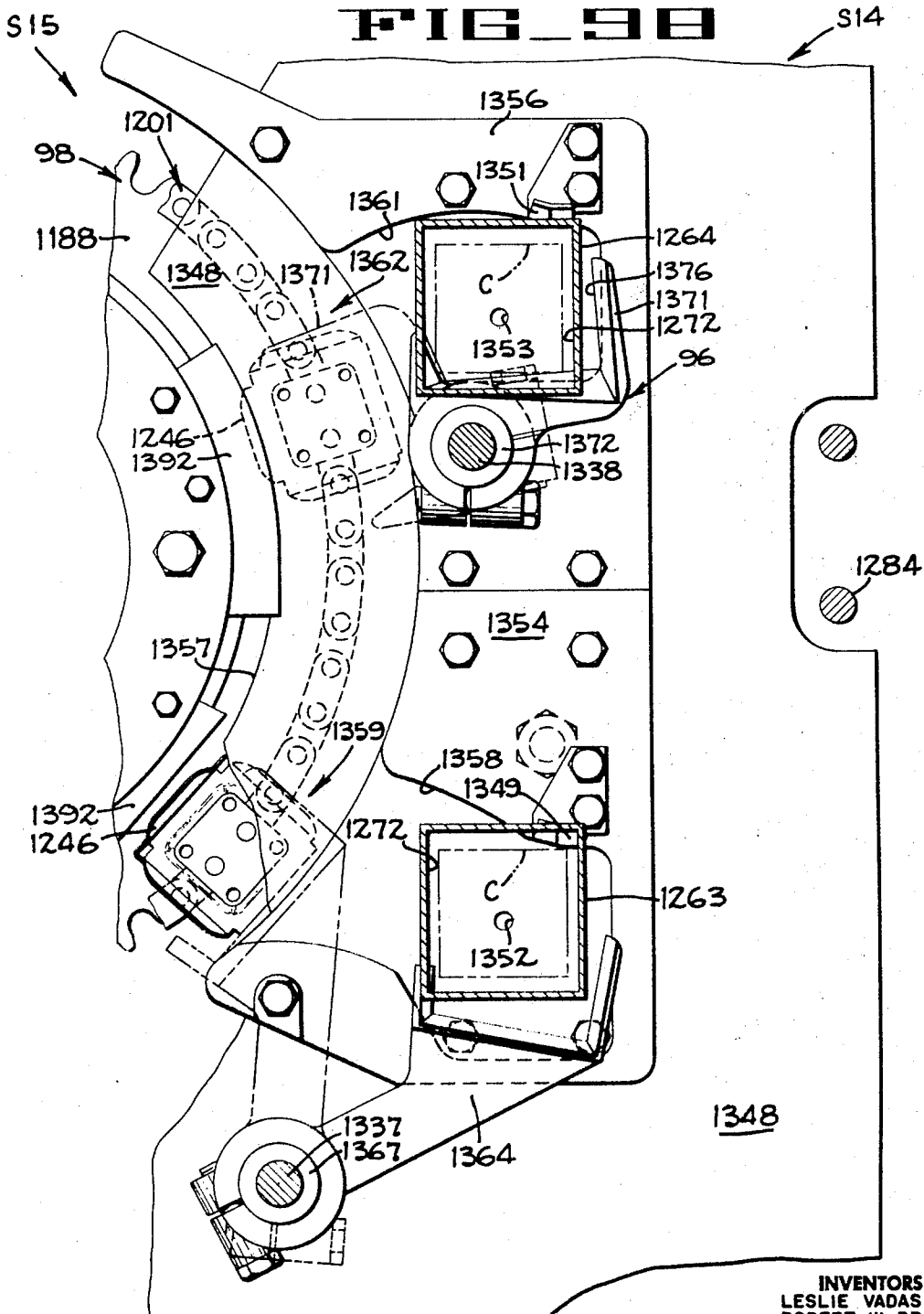
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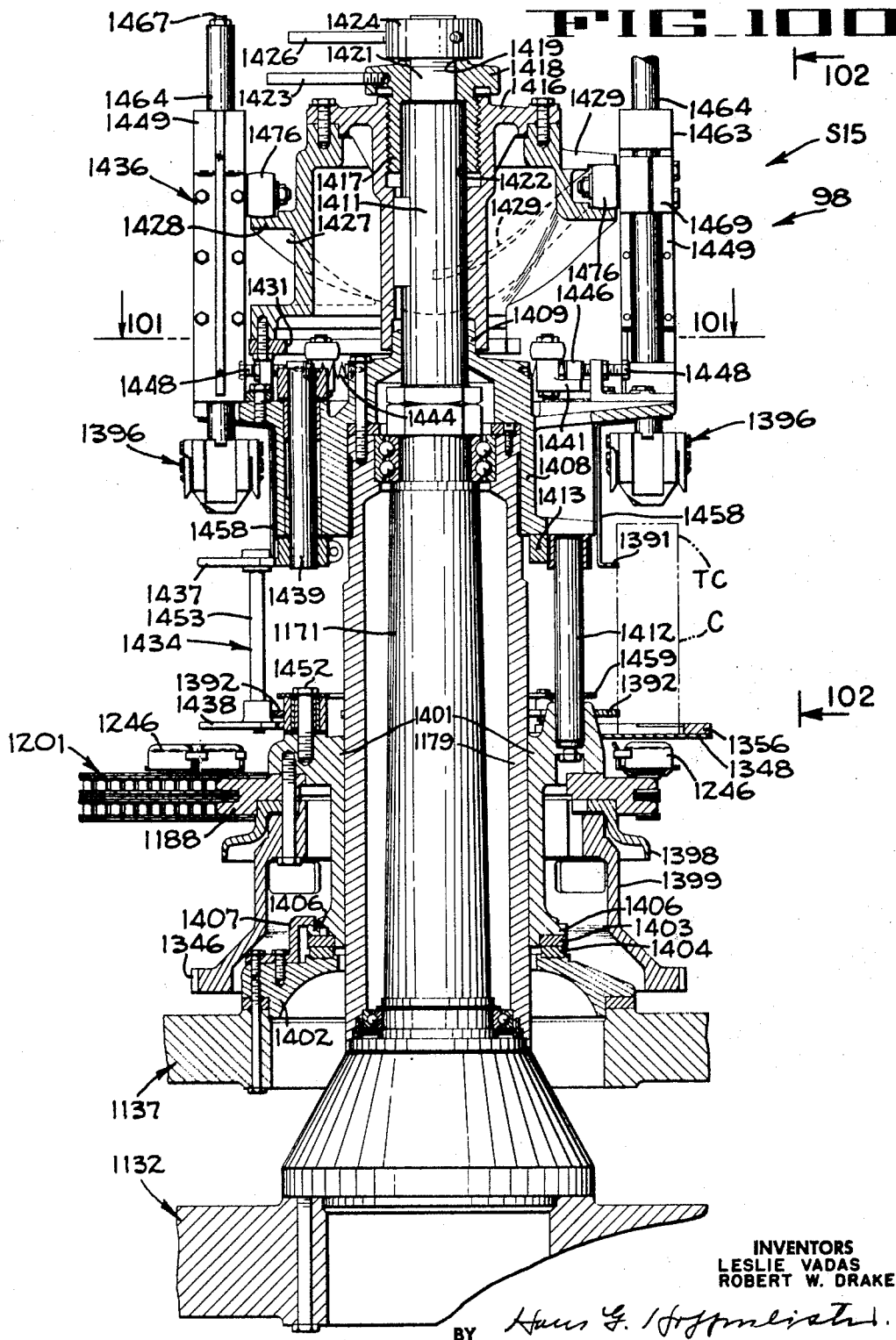
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FIG 103

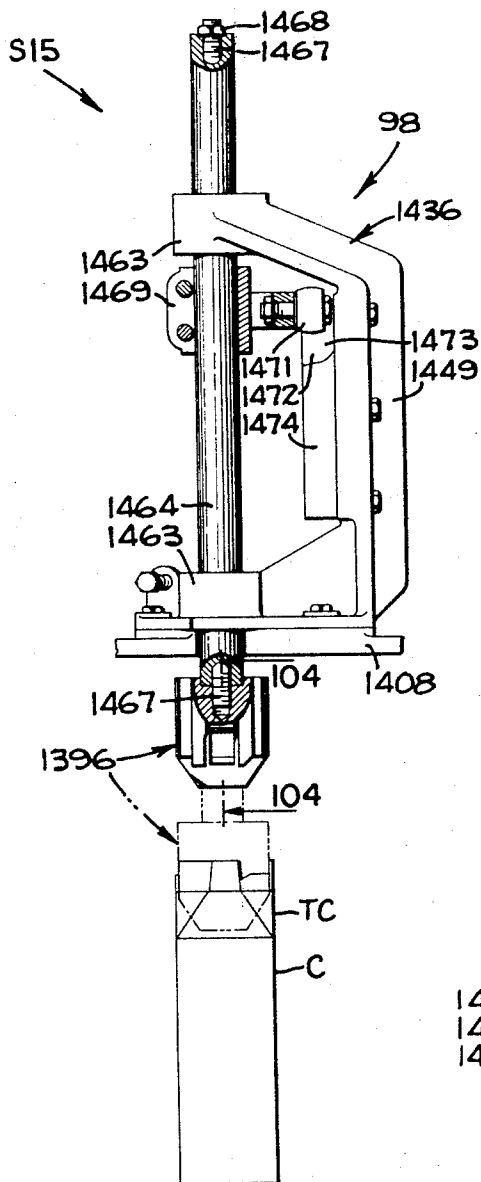
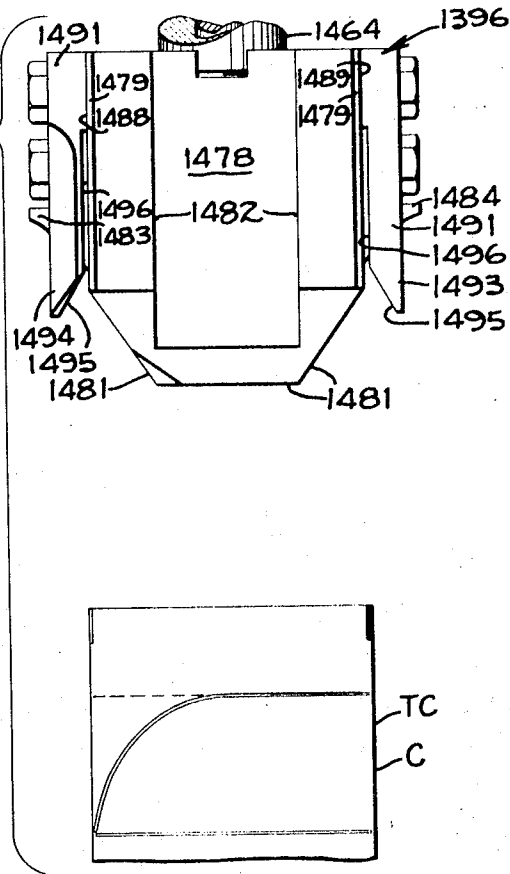
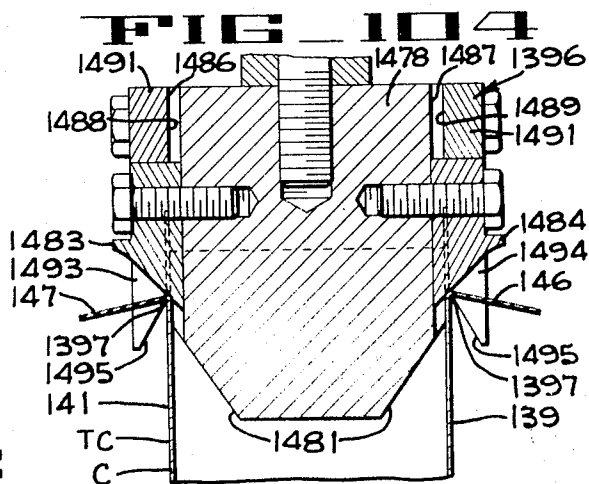


FIG 102



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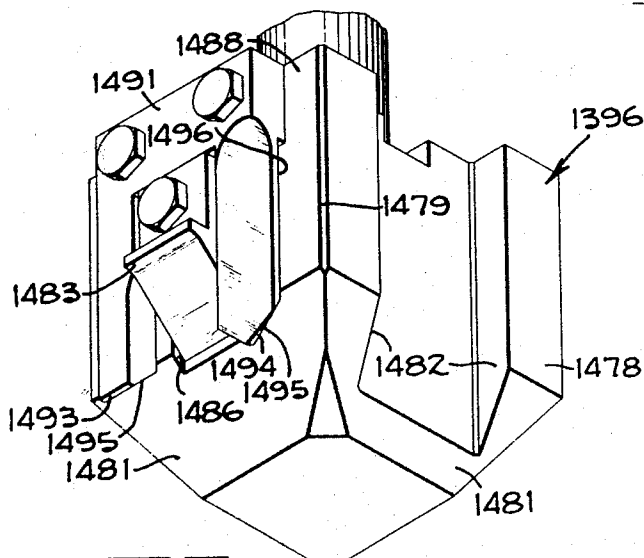


FIG. 105

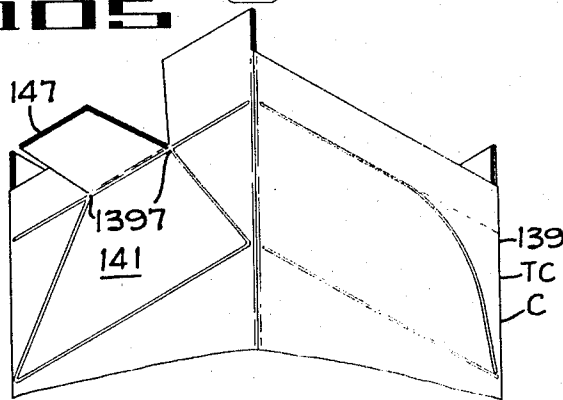


FIG. 106

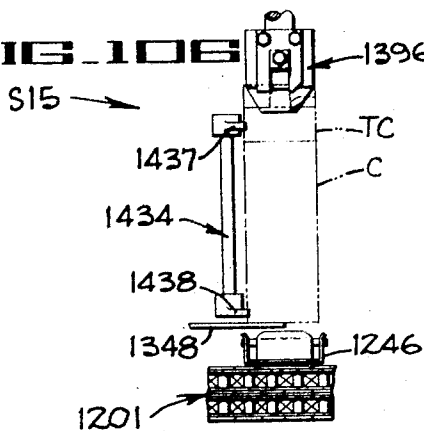
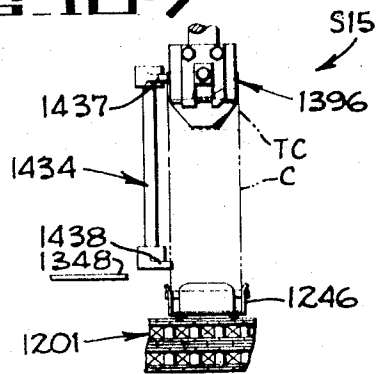


FIG. 107



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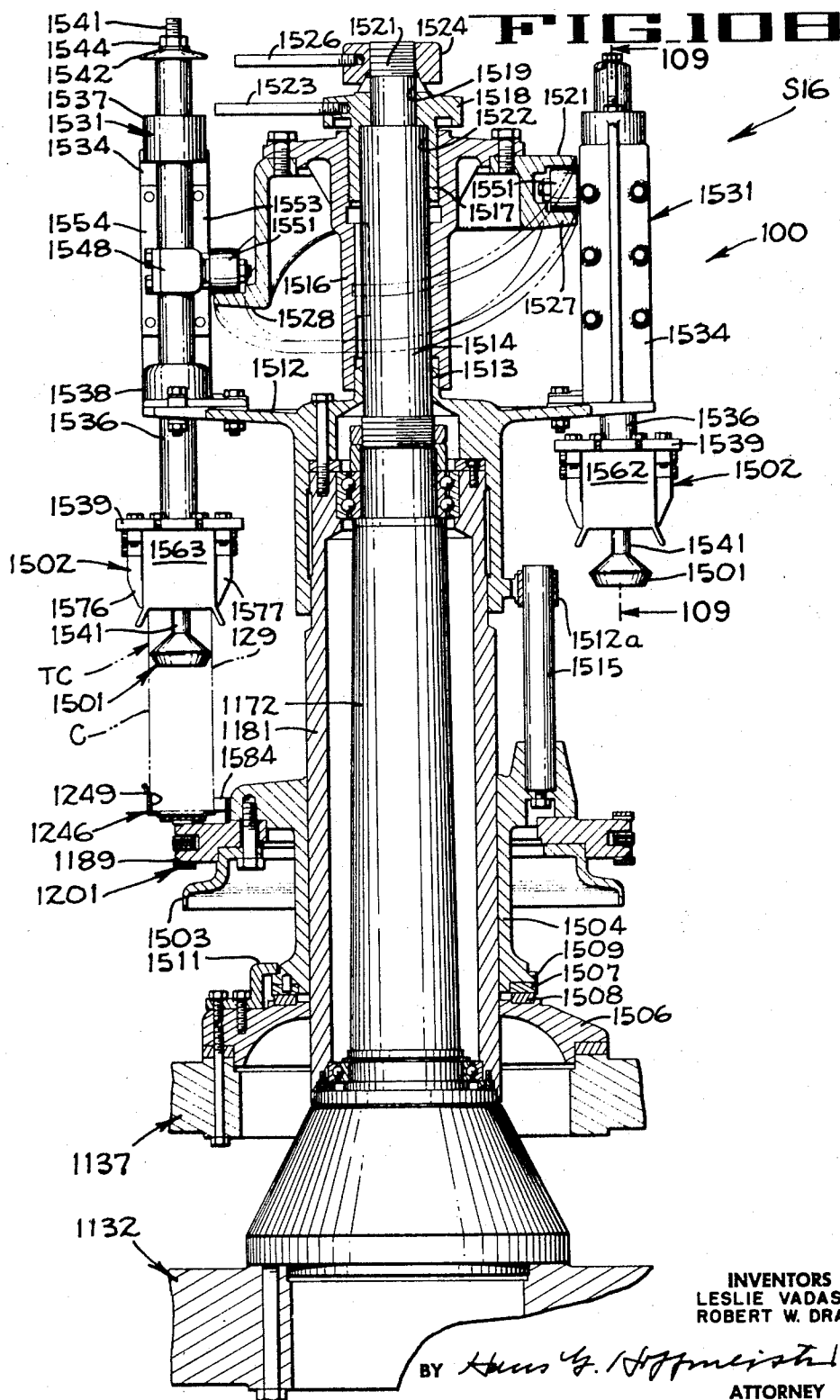
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FIG. 109

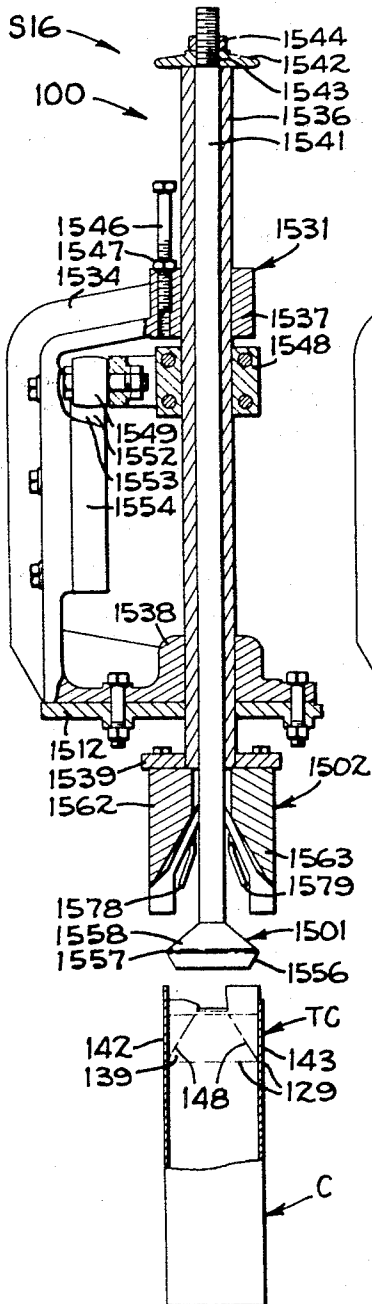


FIG. 110

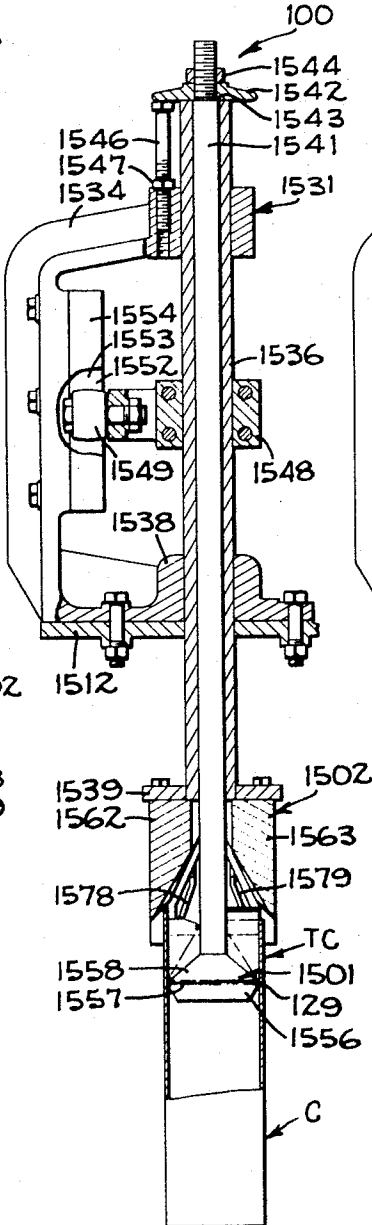
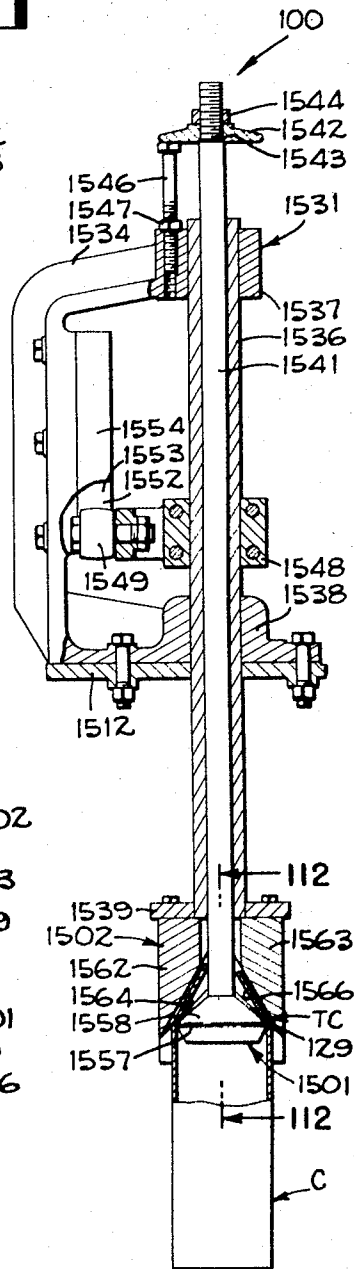


FIG. 111



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FIG. 112

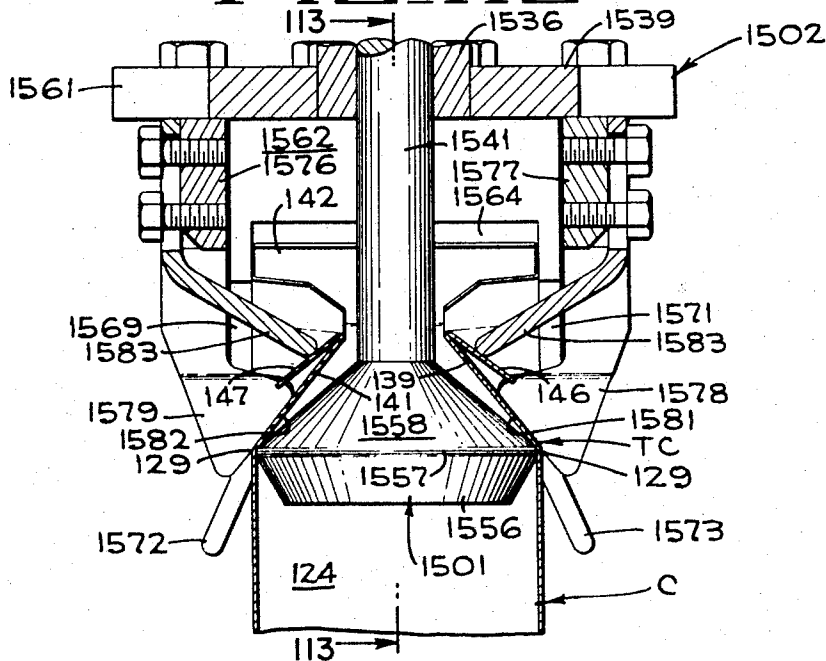
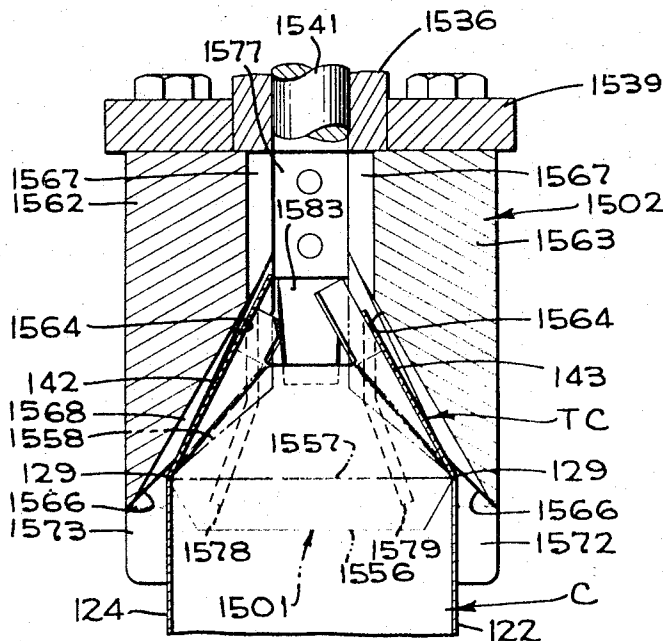


FIG. 113

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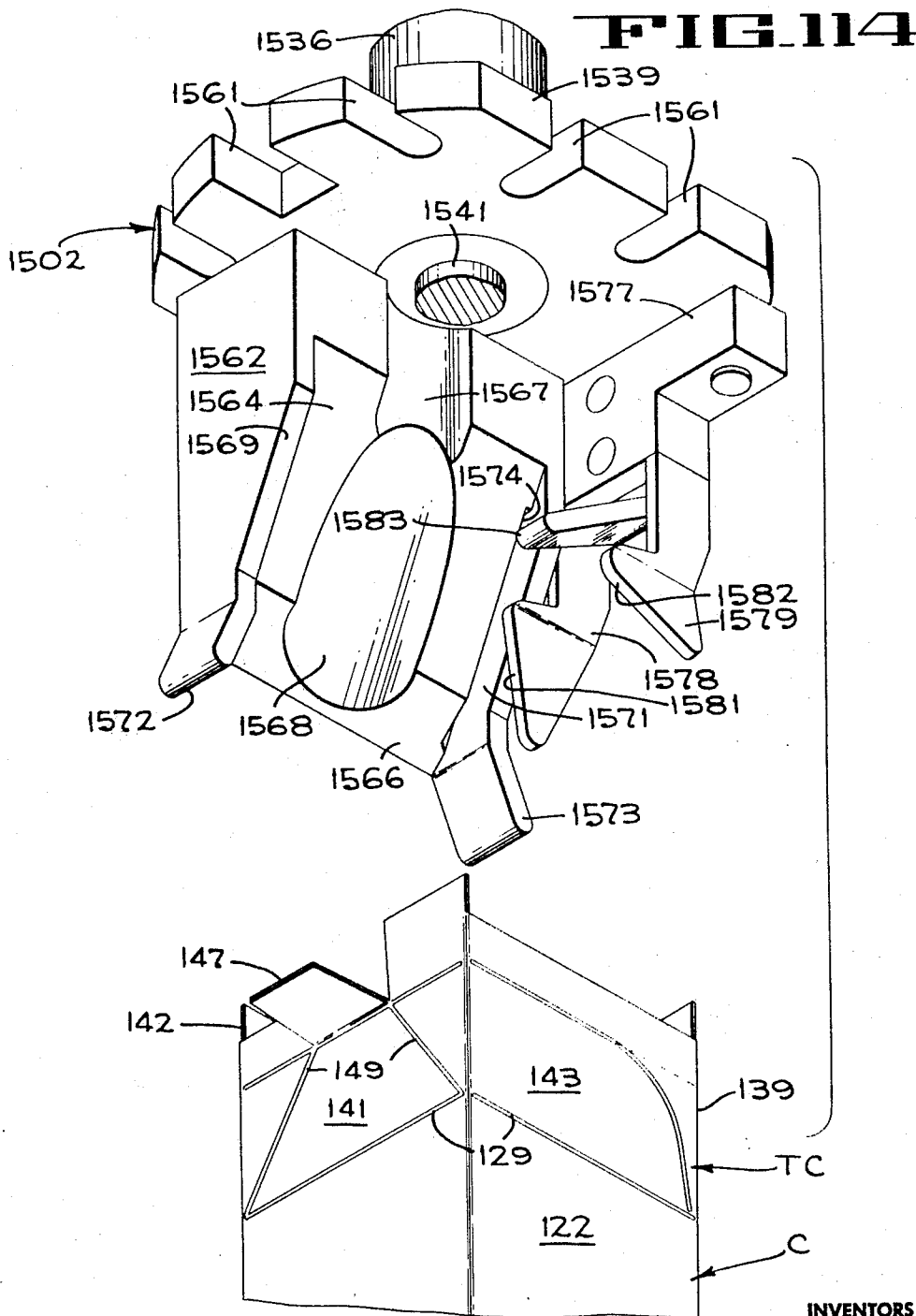
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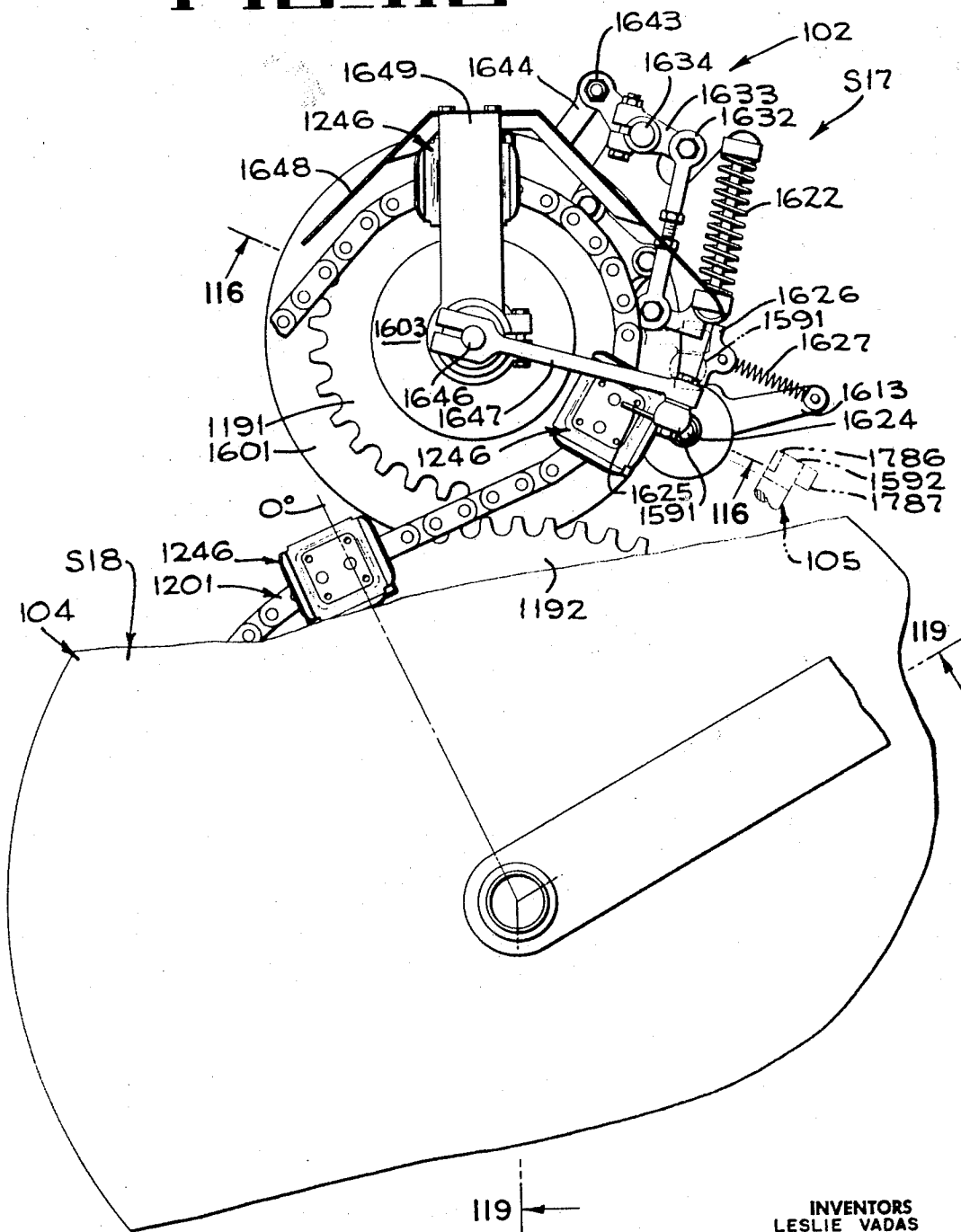
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FIG_115



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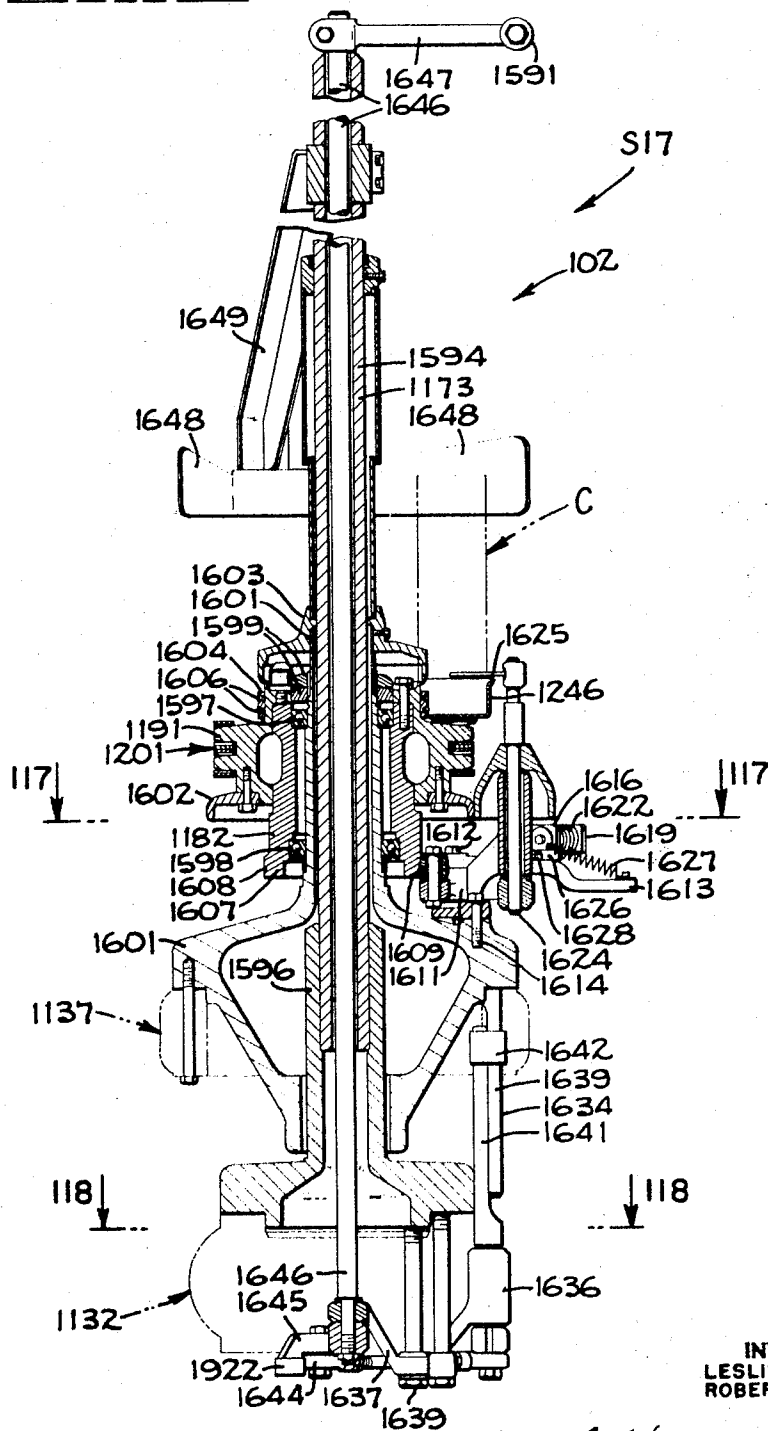
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FIG. 116



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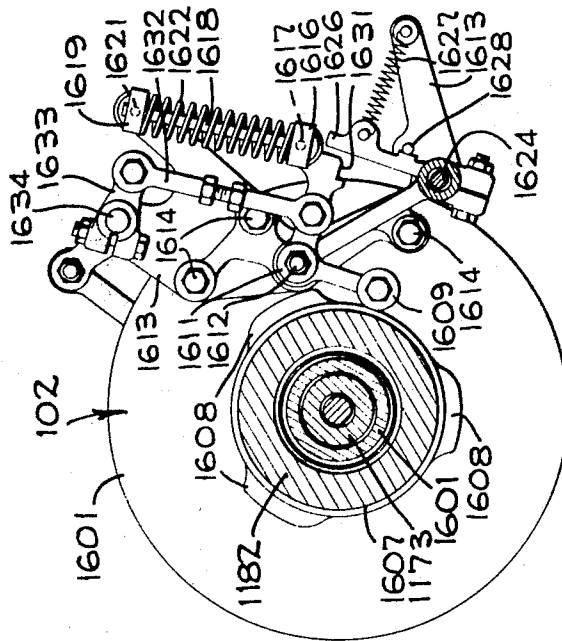
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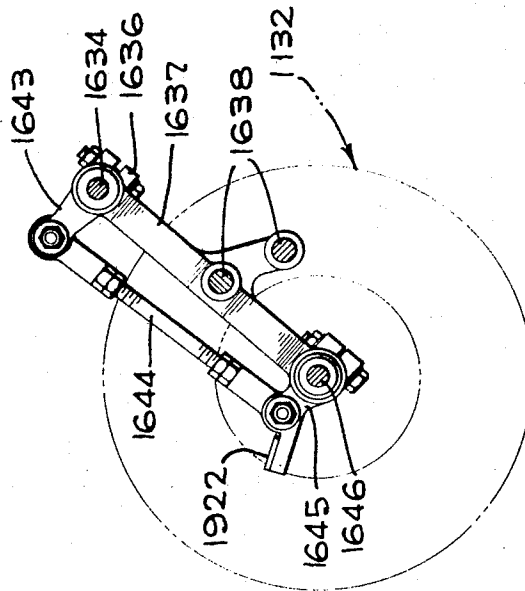
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FILE-117



FILE



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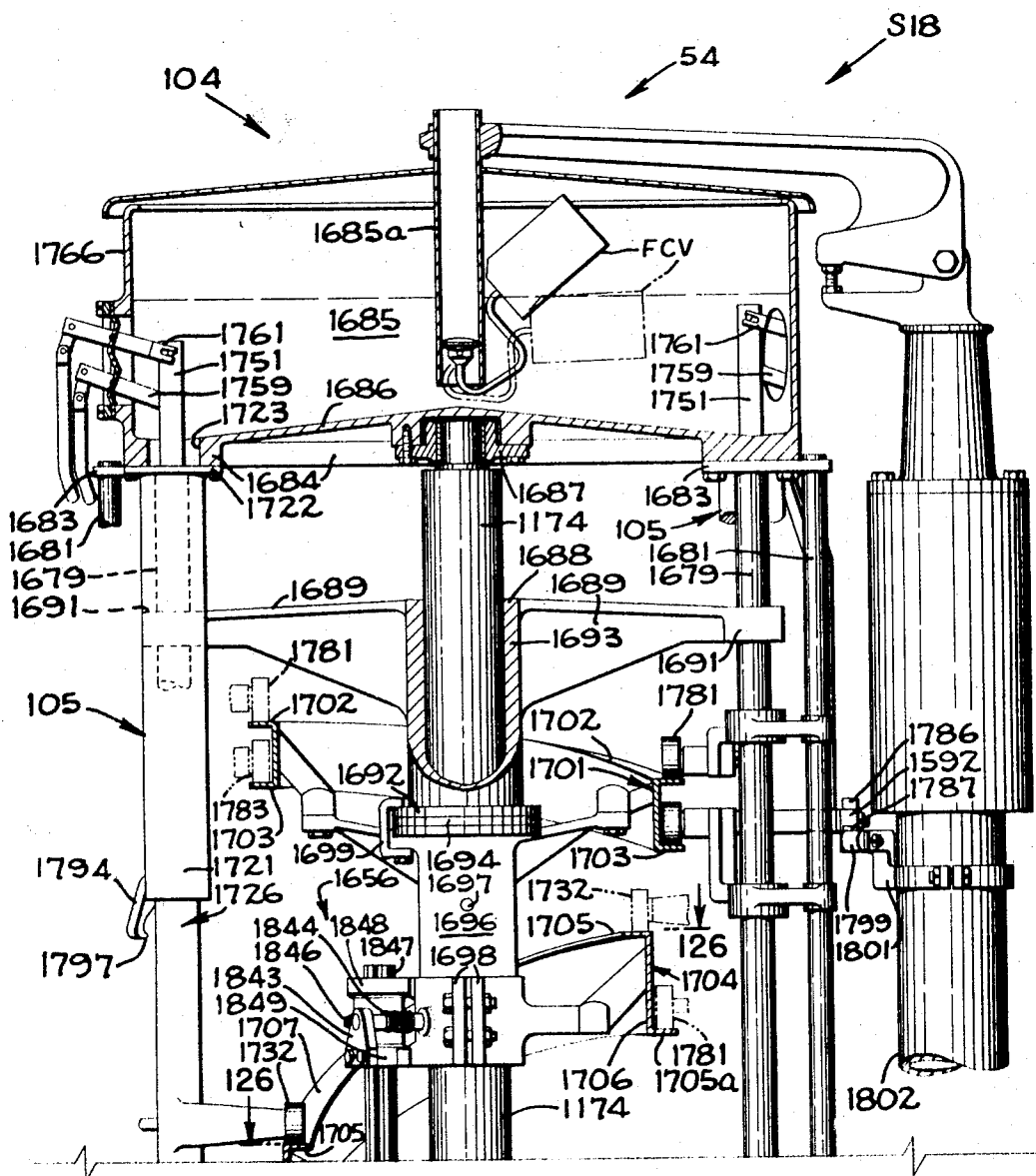
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FIG. 119A



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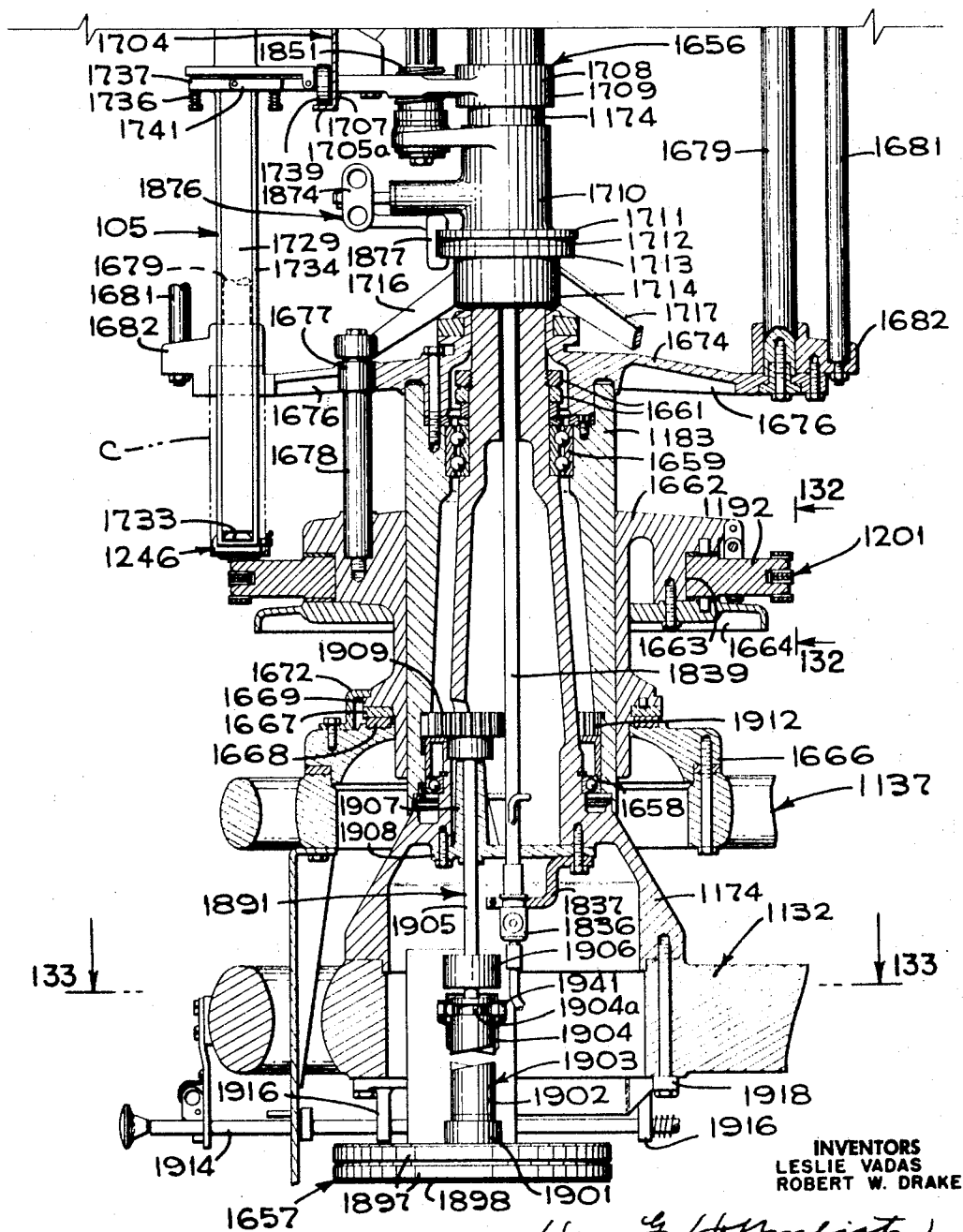
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FIG. 118B



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FIG 121

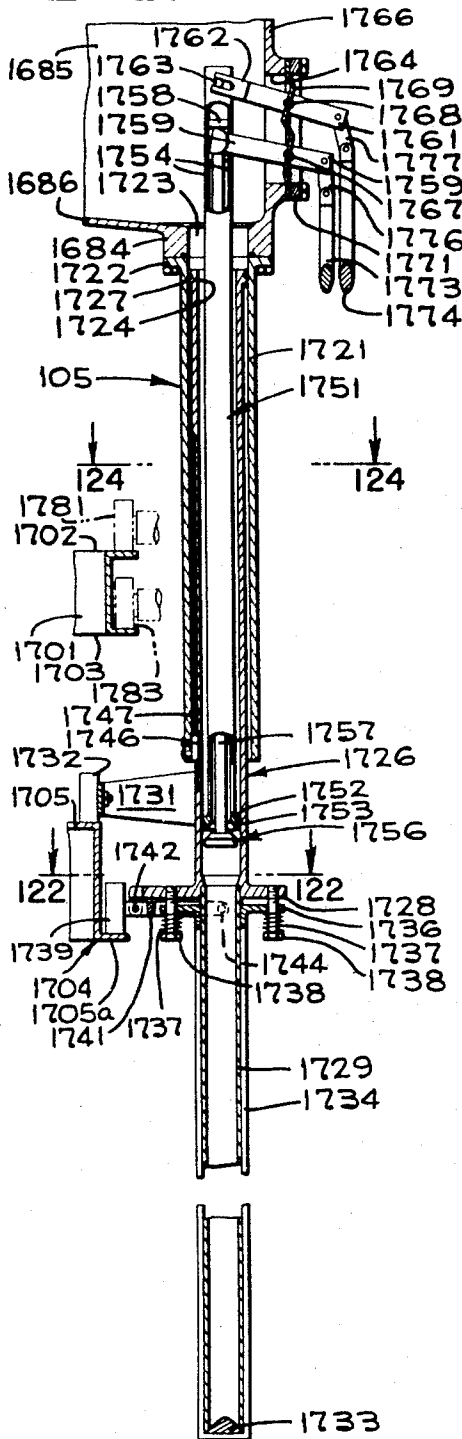
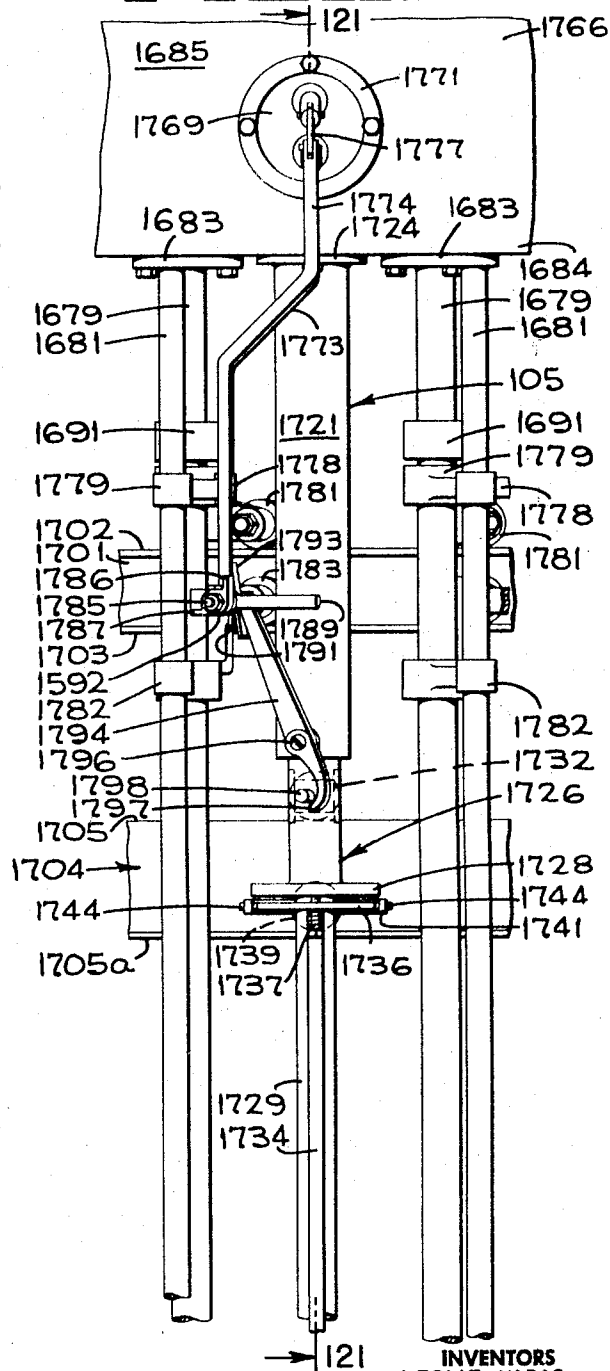


FIG 120



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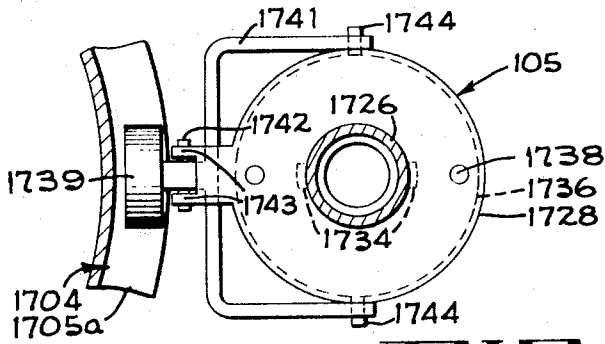


FIG. 122

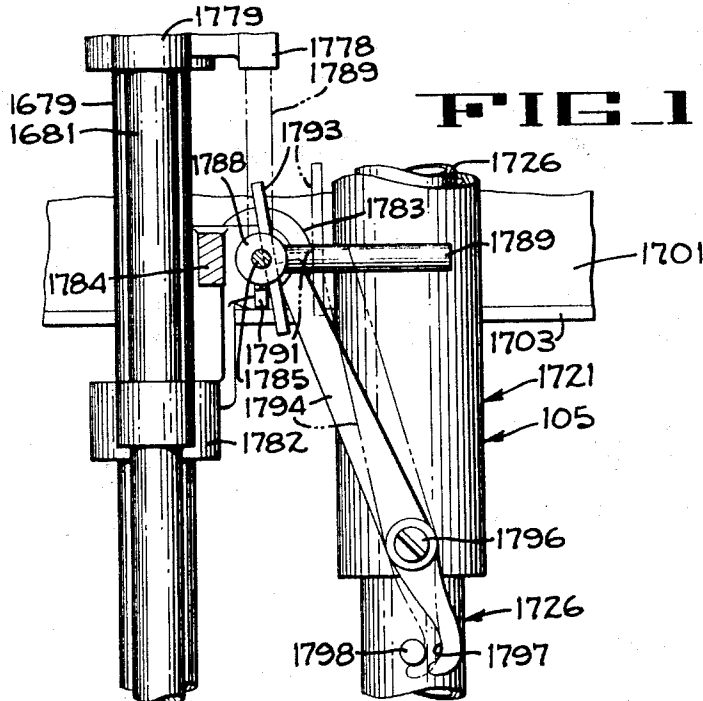


FIG. 123

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FIG 124

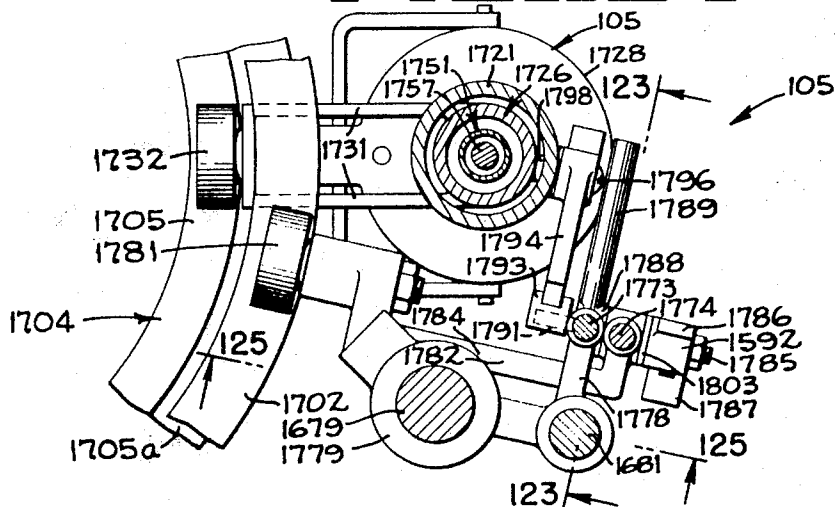
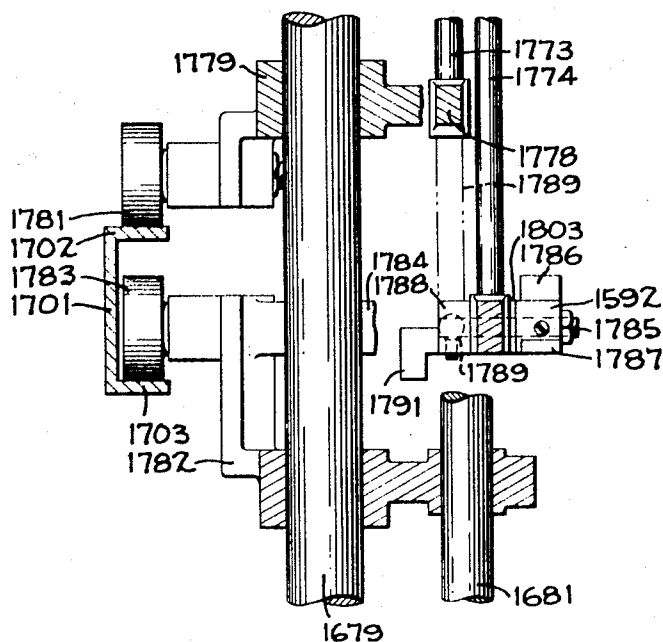


FIG 125



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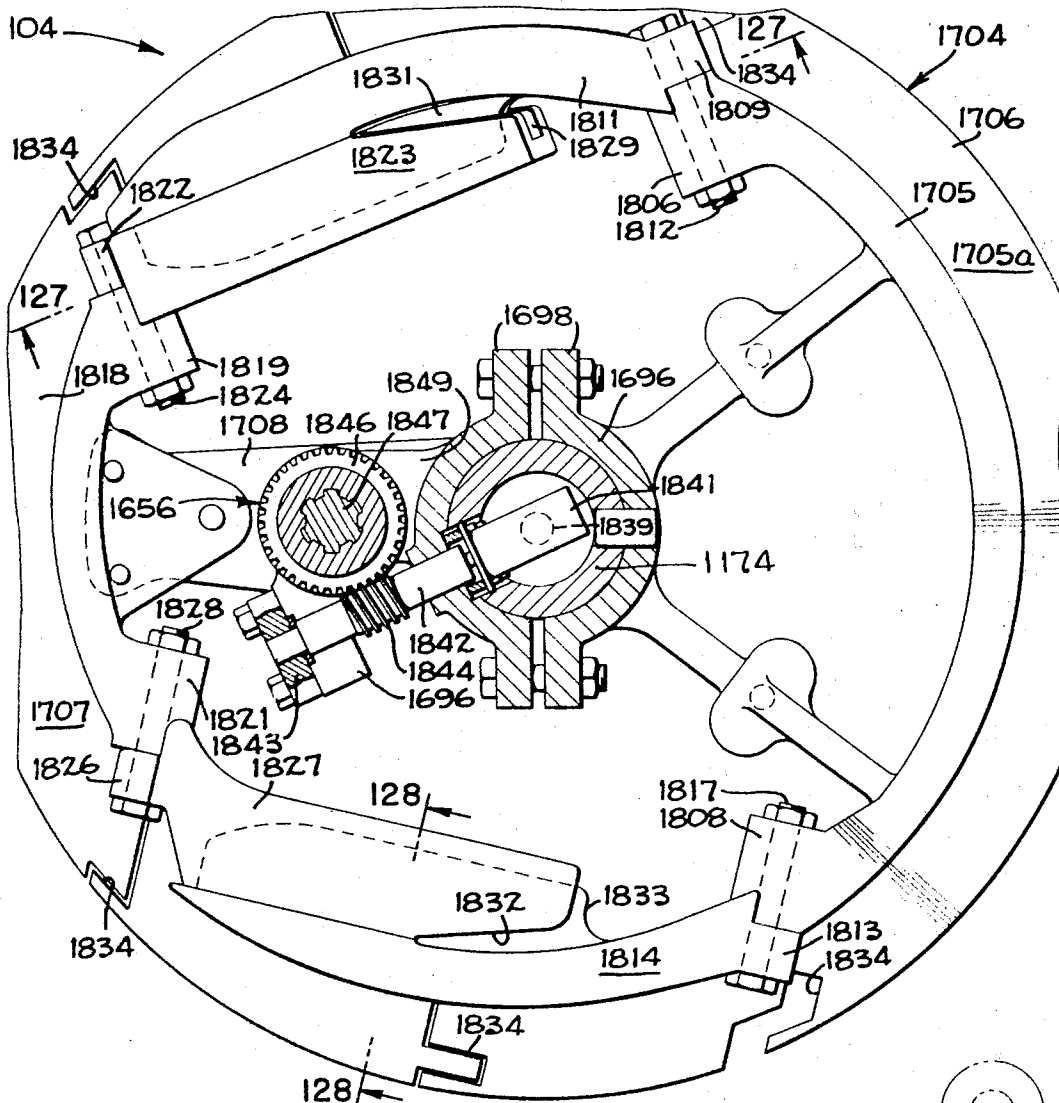
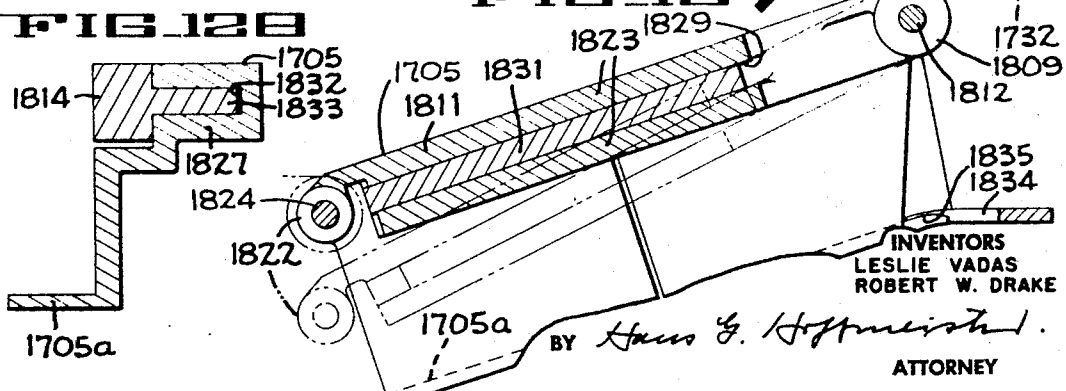


FIG. 126

FIG. 127

FIG. 128



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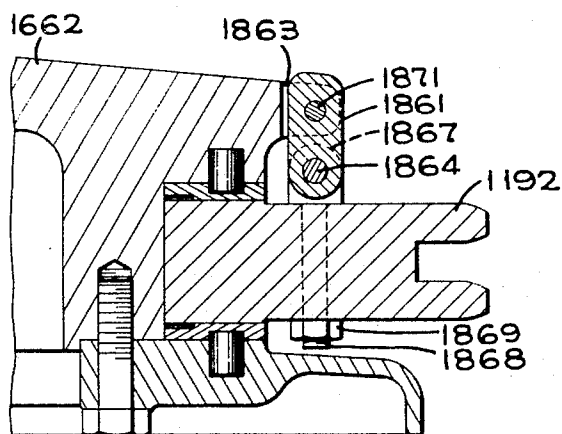


FIG 131

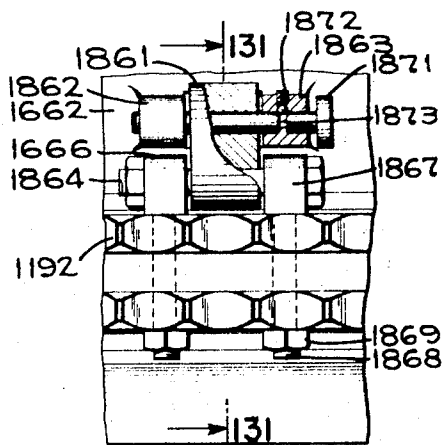


FIG 132

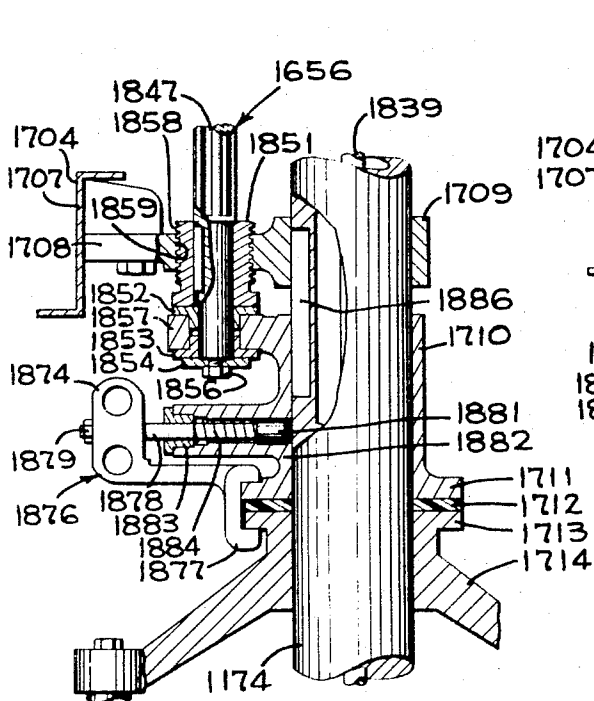


FIG 129

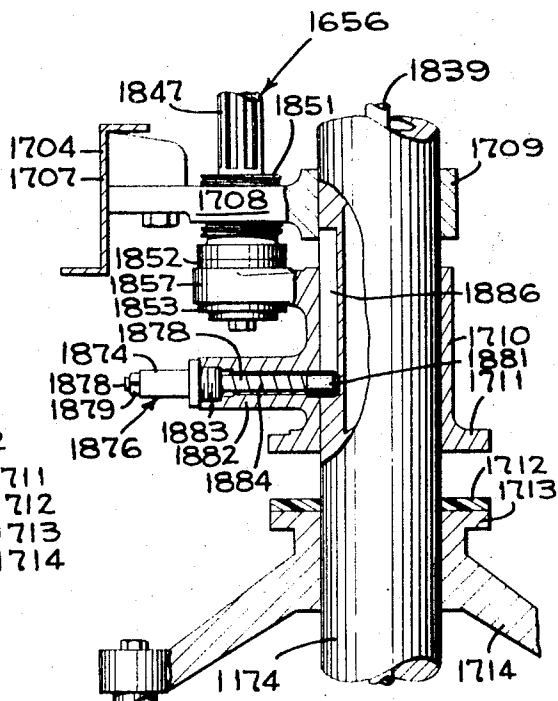


FIG 130

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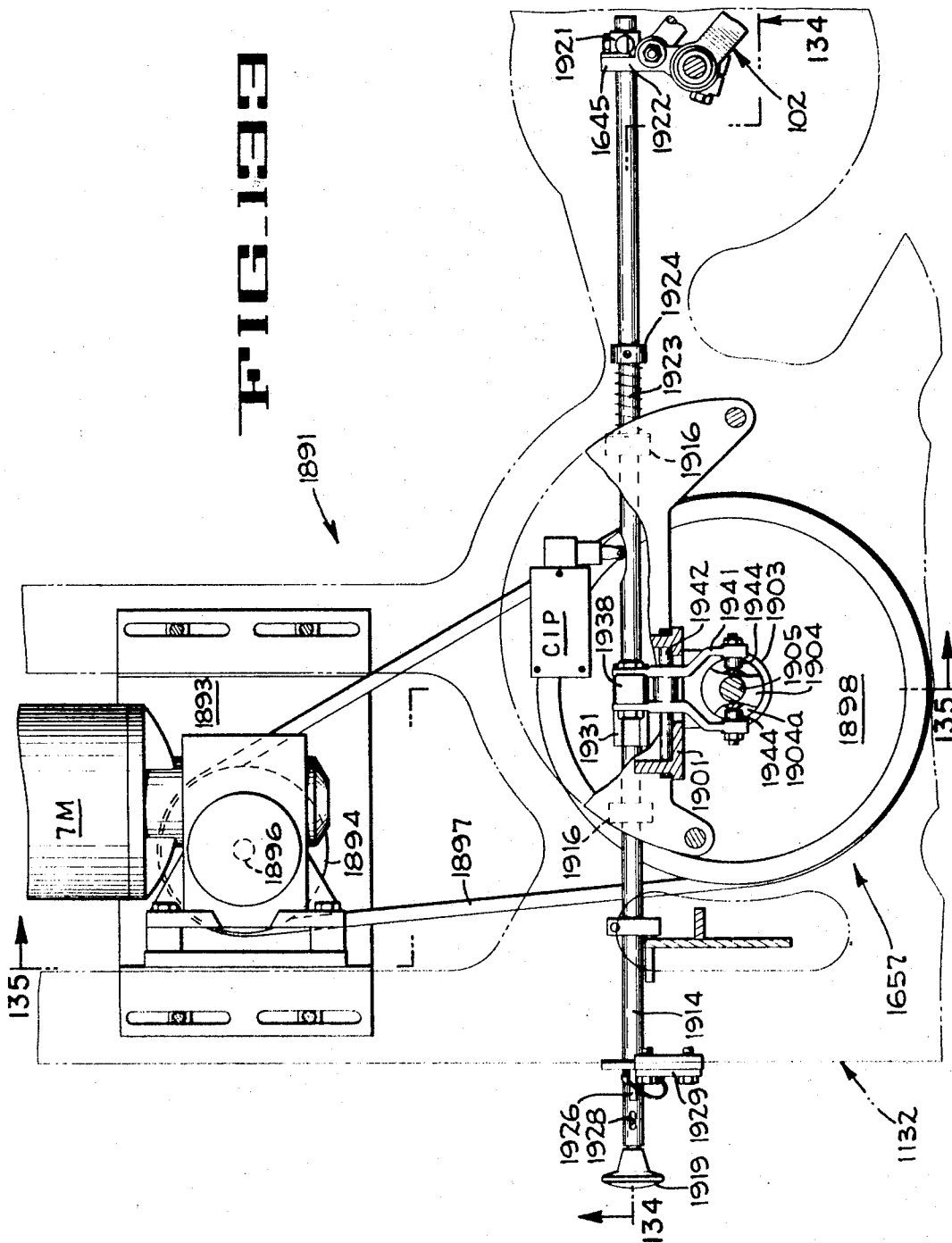
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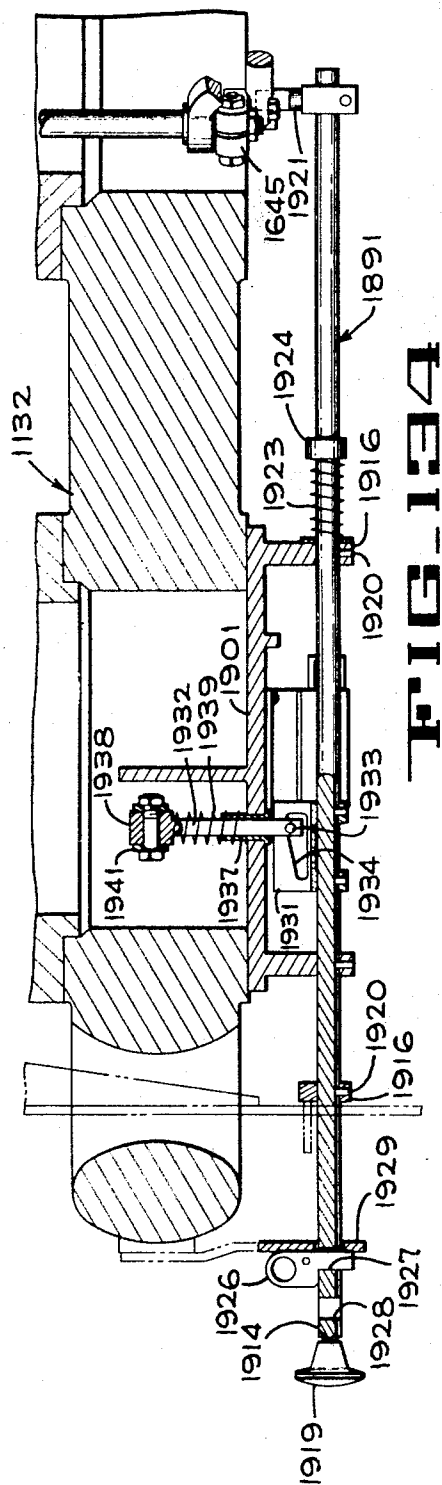
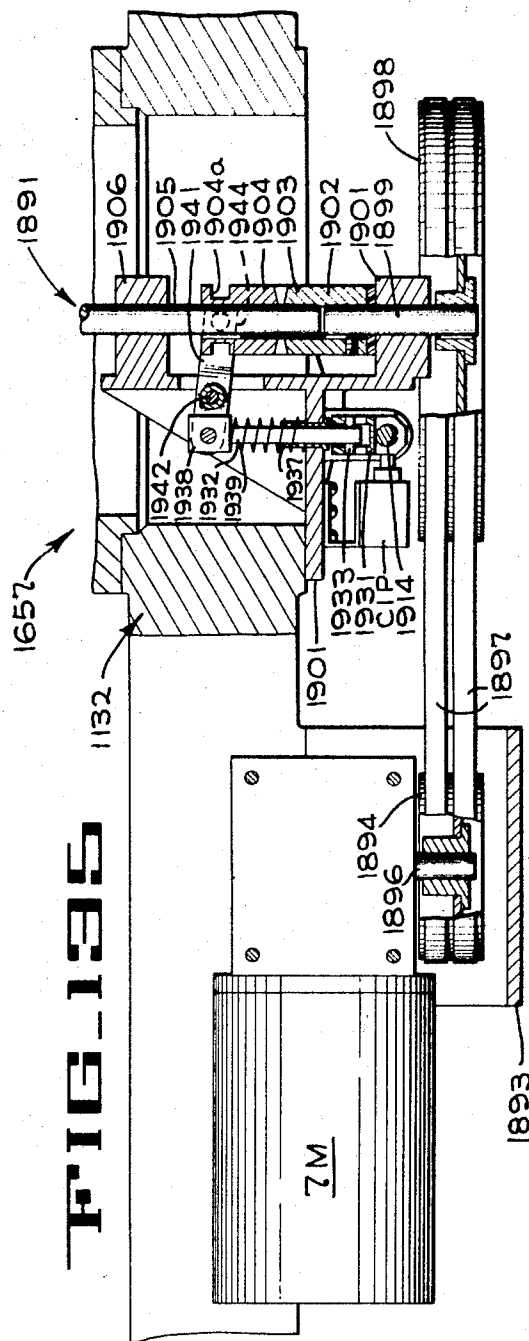
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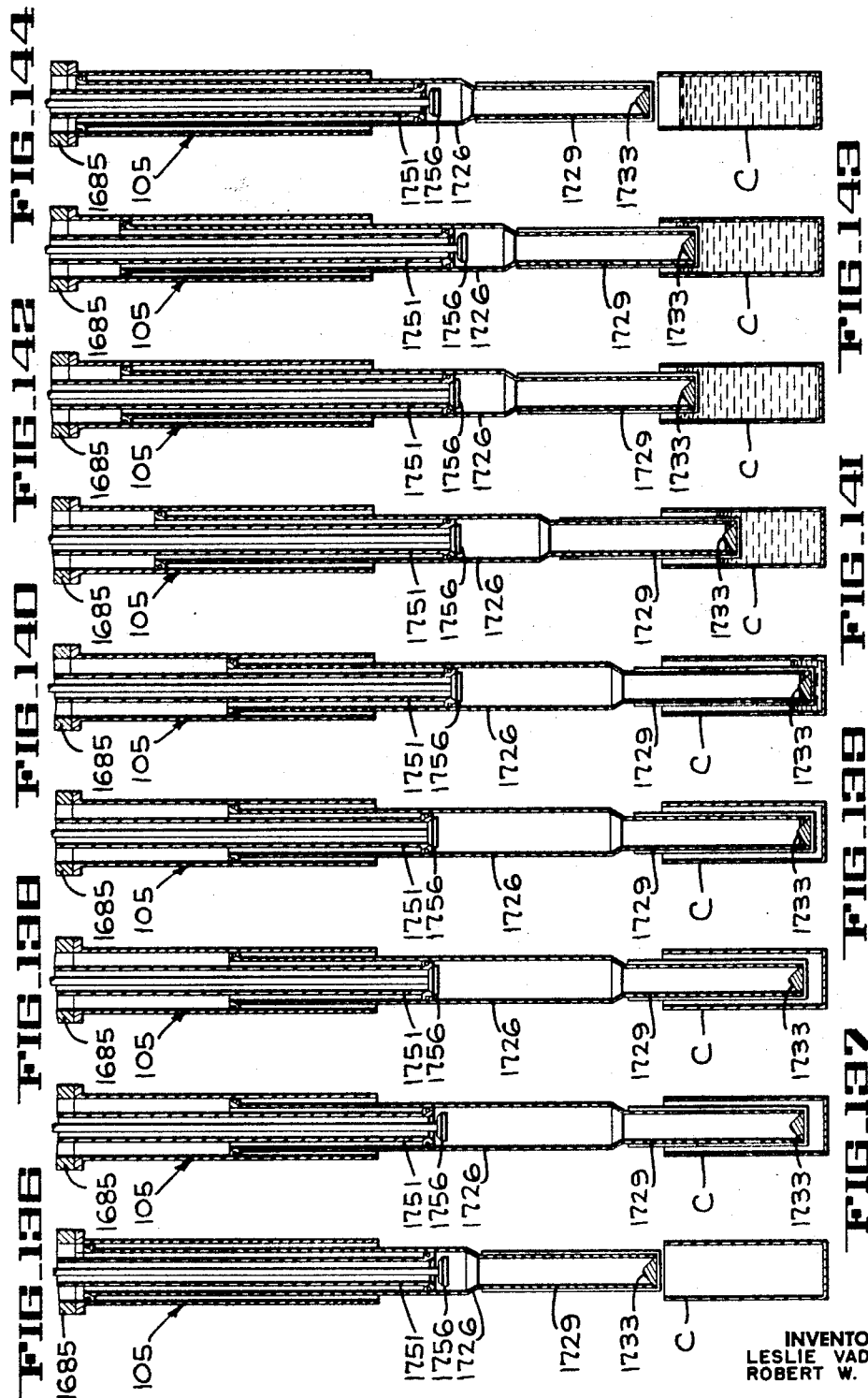
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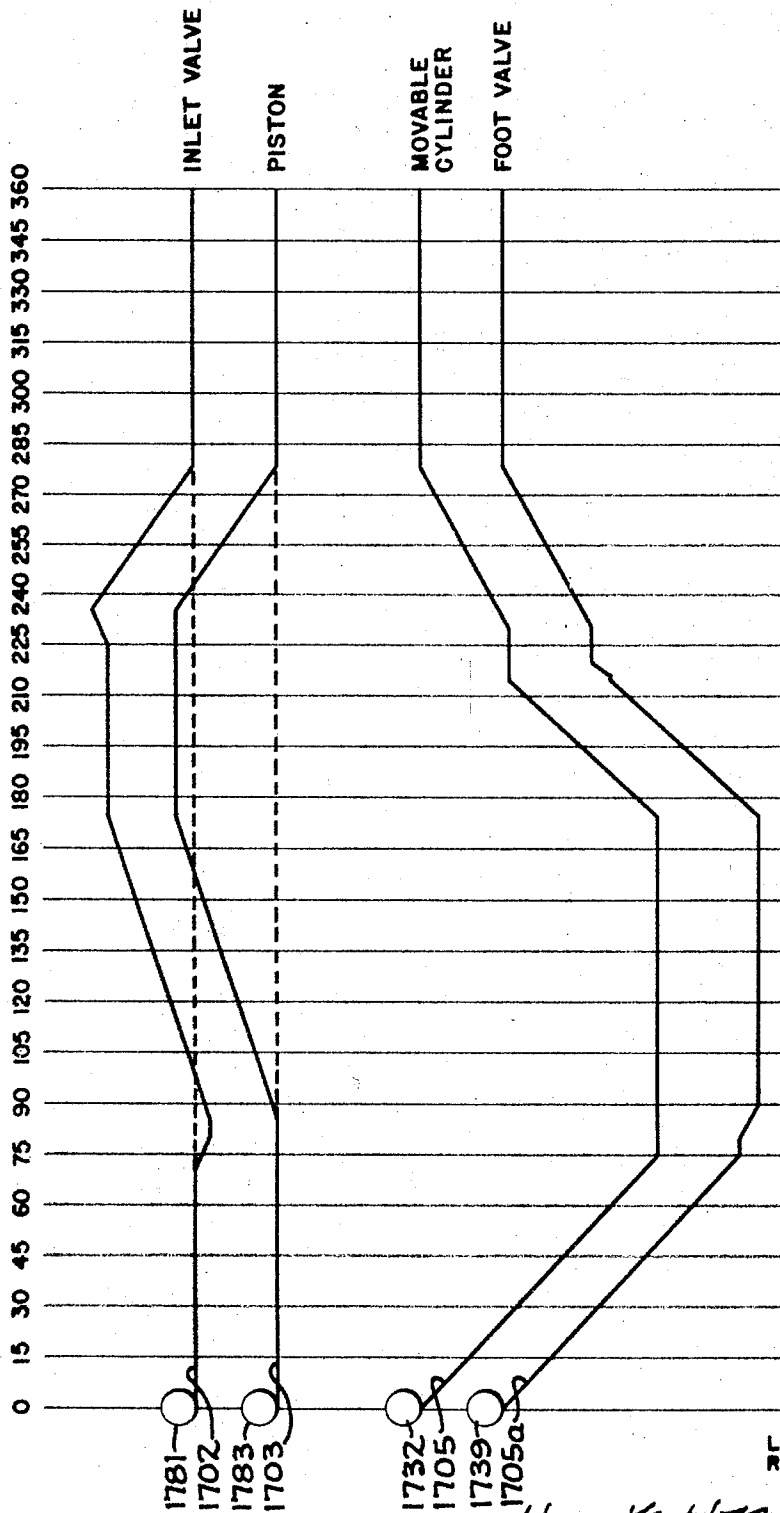


FIG. 145

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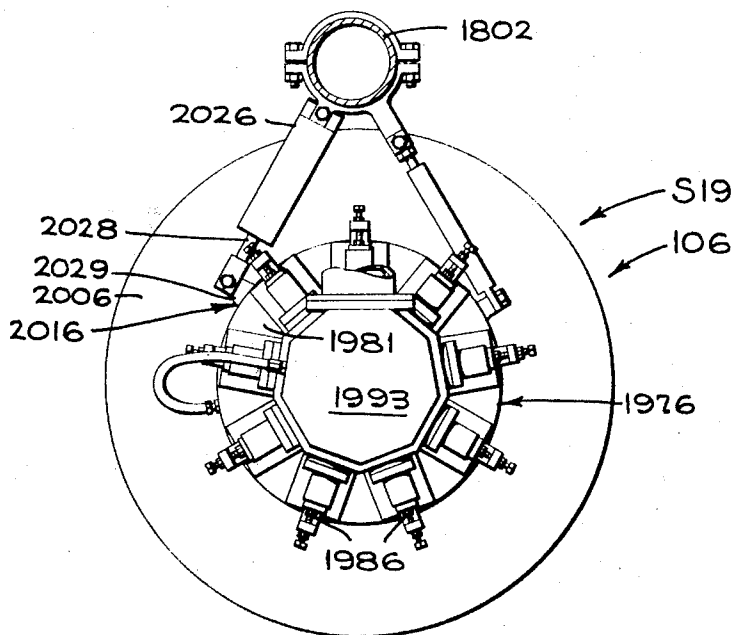


FIG. 148

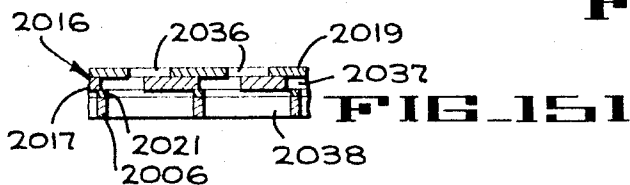


FIG. 151

FIG. 150

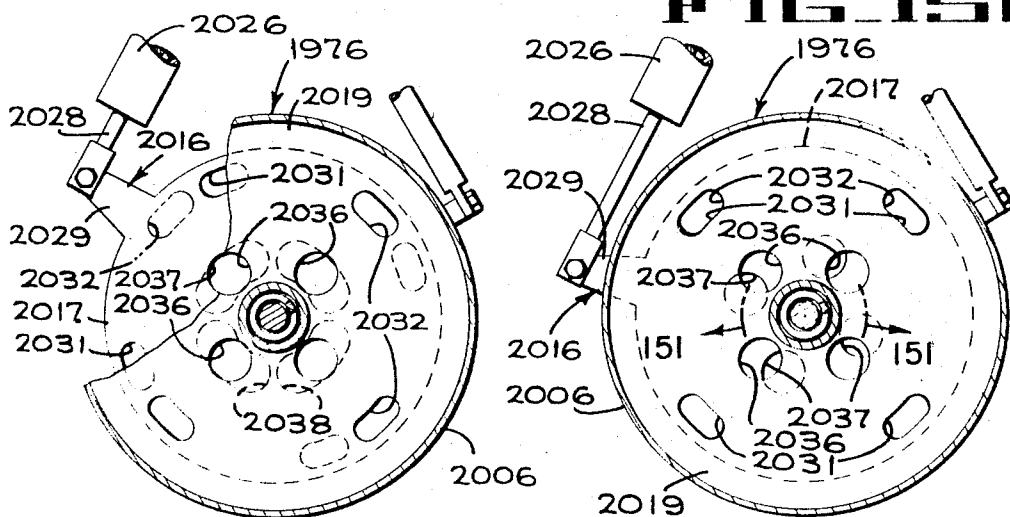


FIG. 149

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FIG. 152

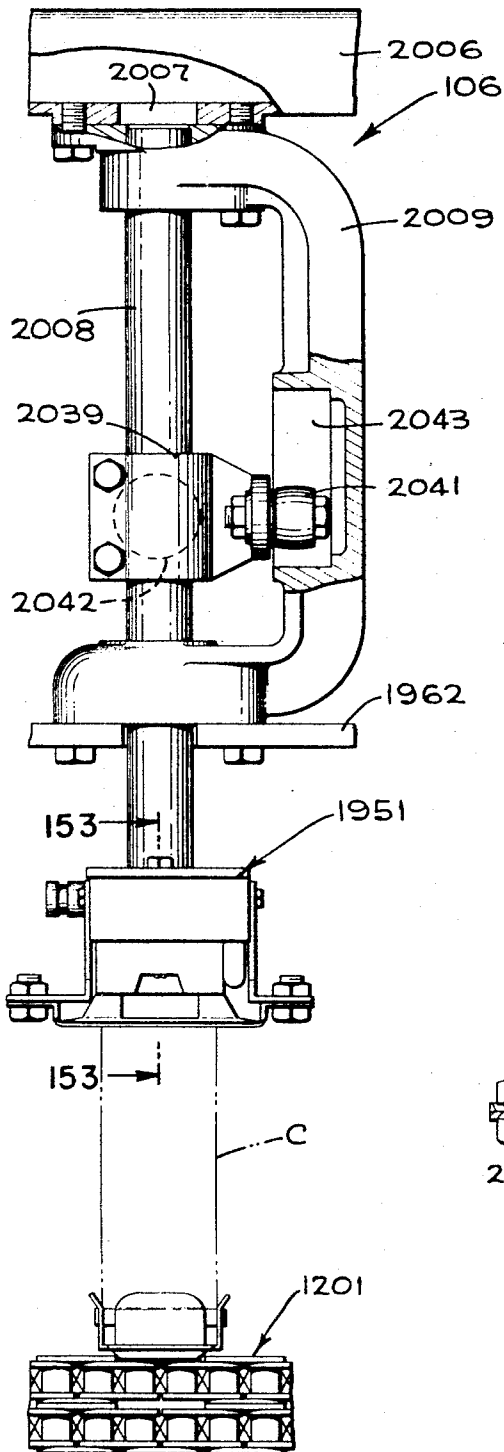


FIG. 153

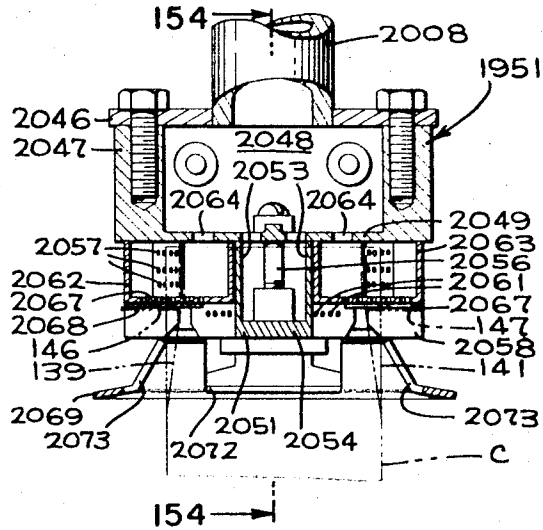
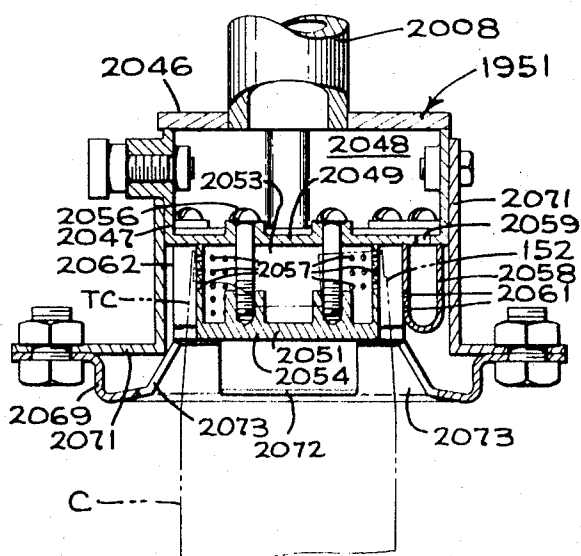


FIG. 154



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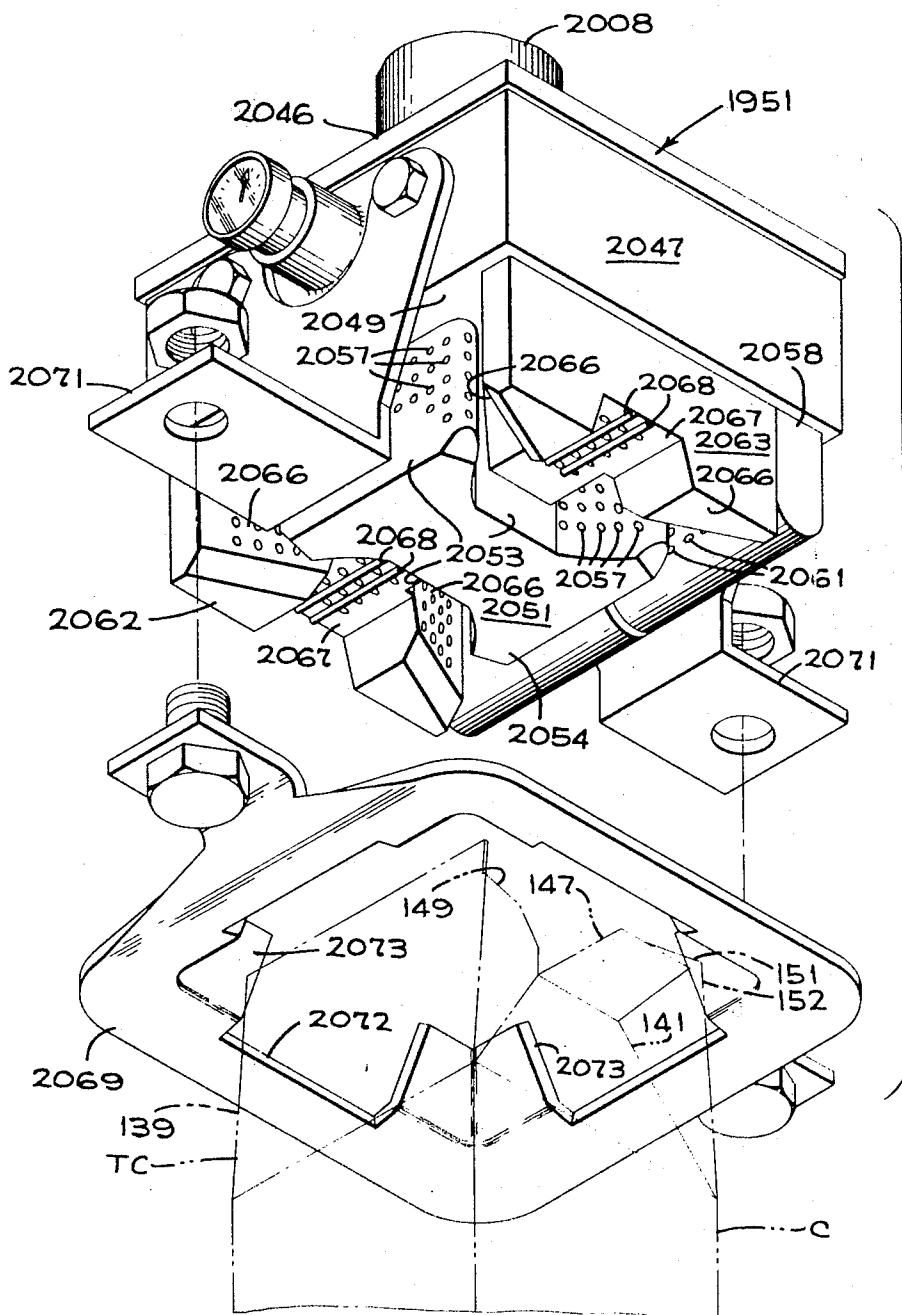
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FIG. 155



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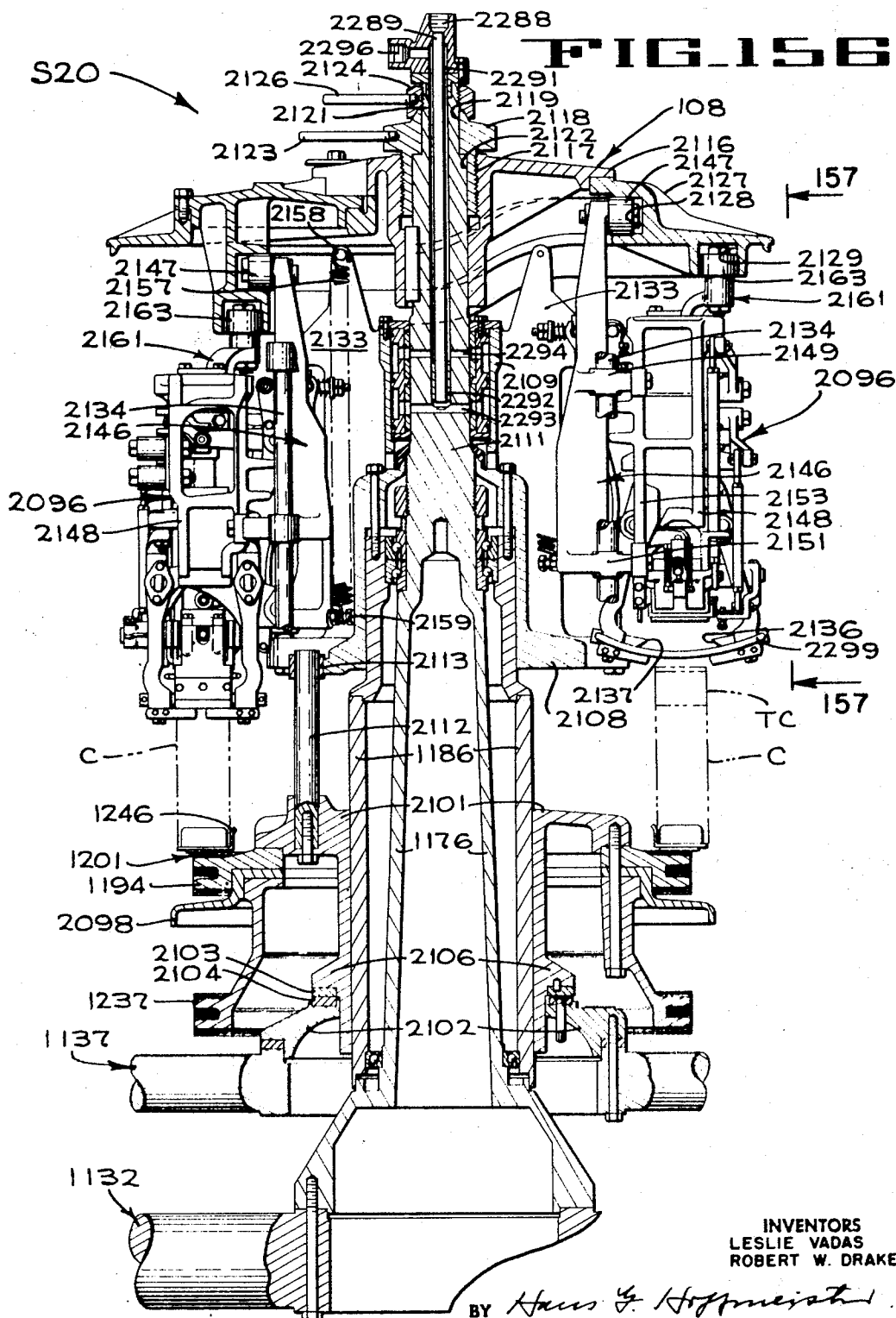
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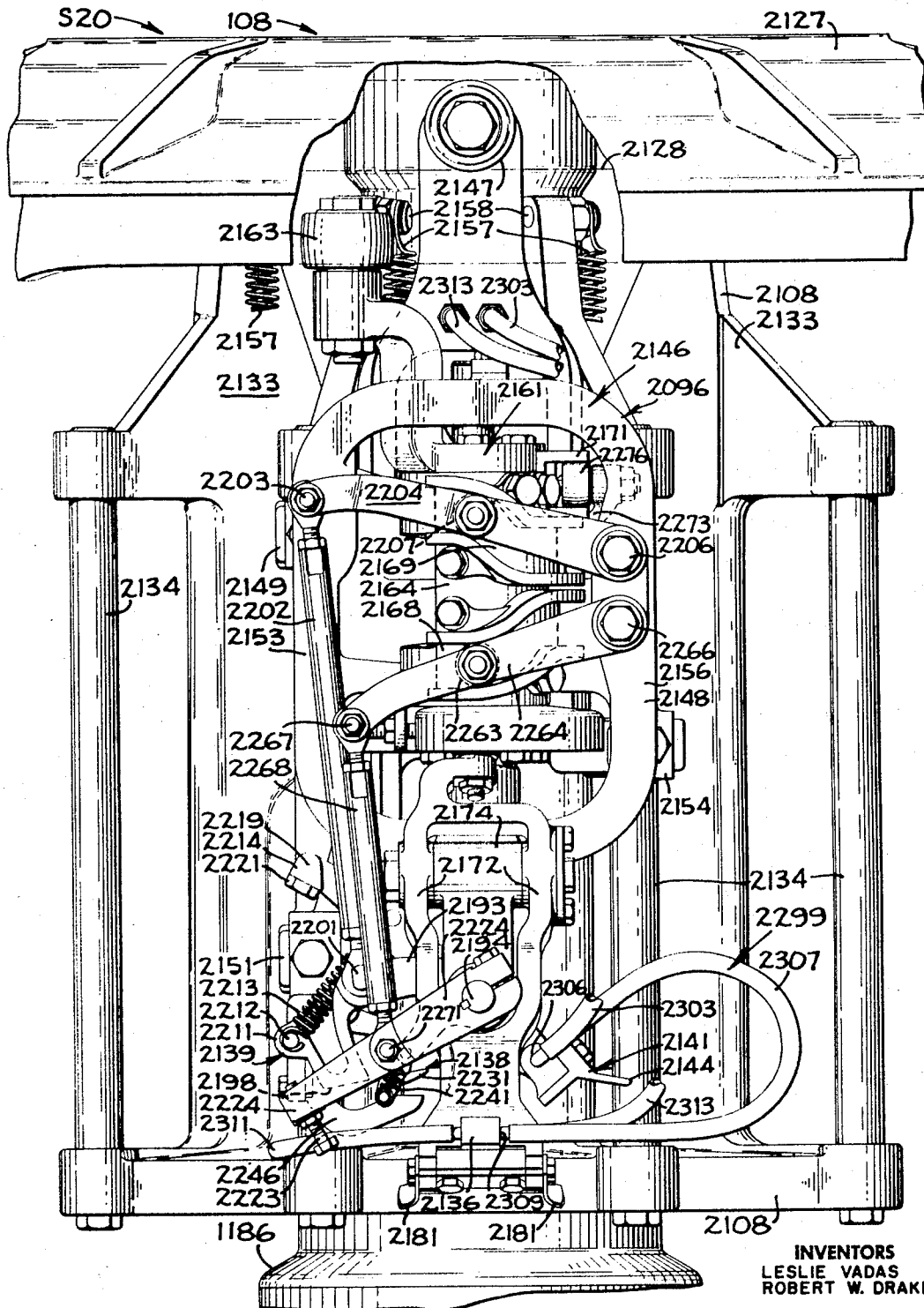


FIG. 157

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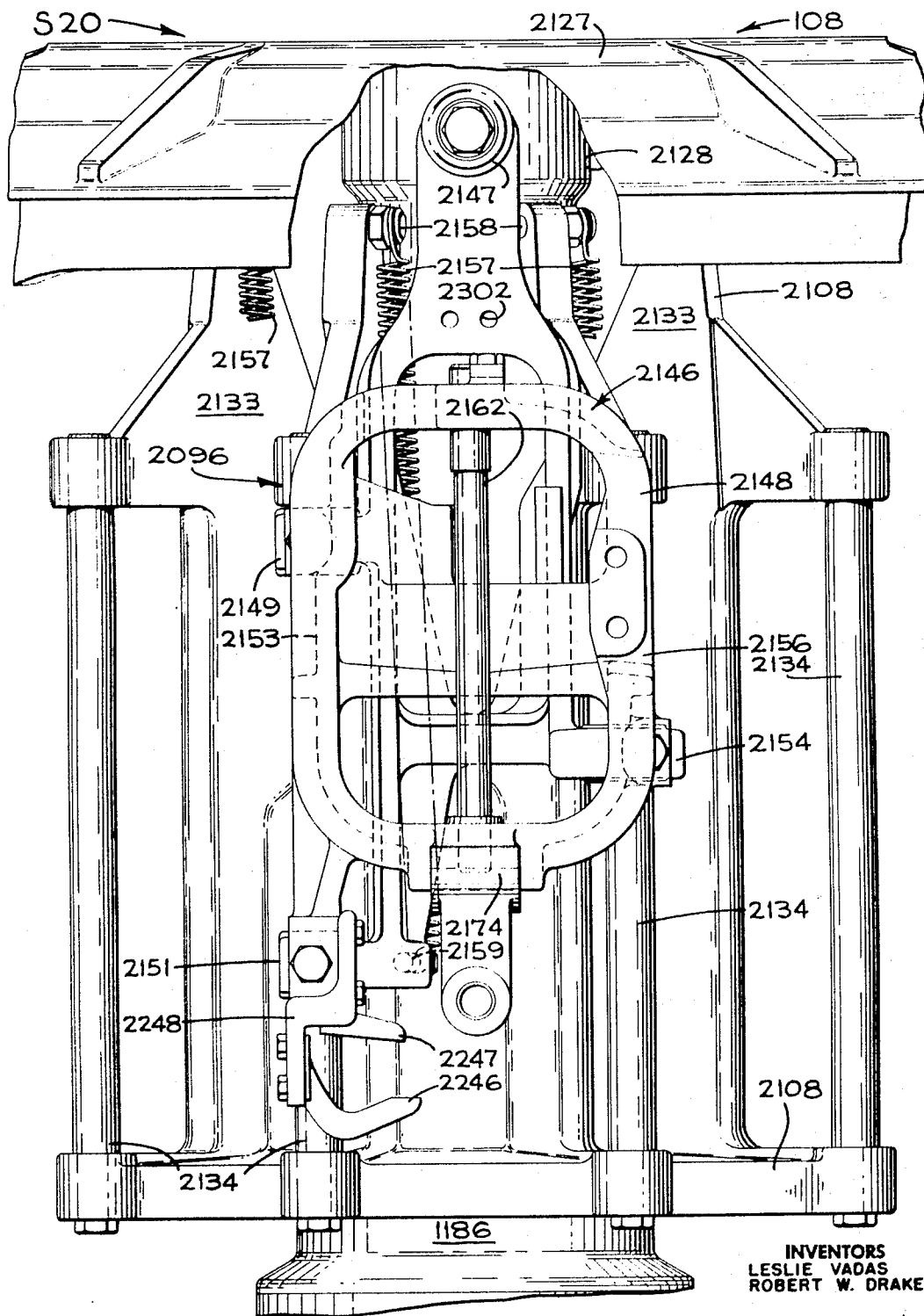


FIG. 158

BY *Hans G. Hoffmeister*
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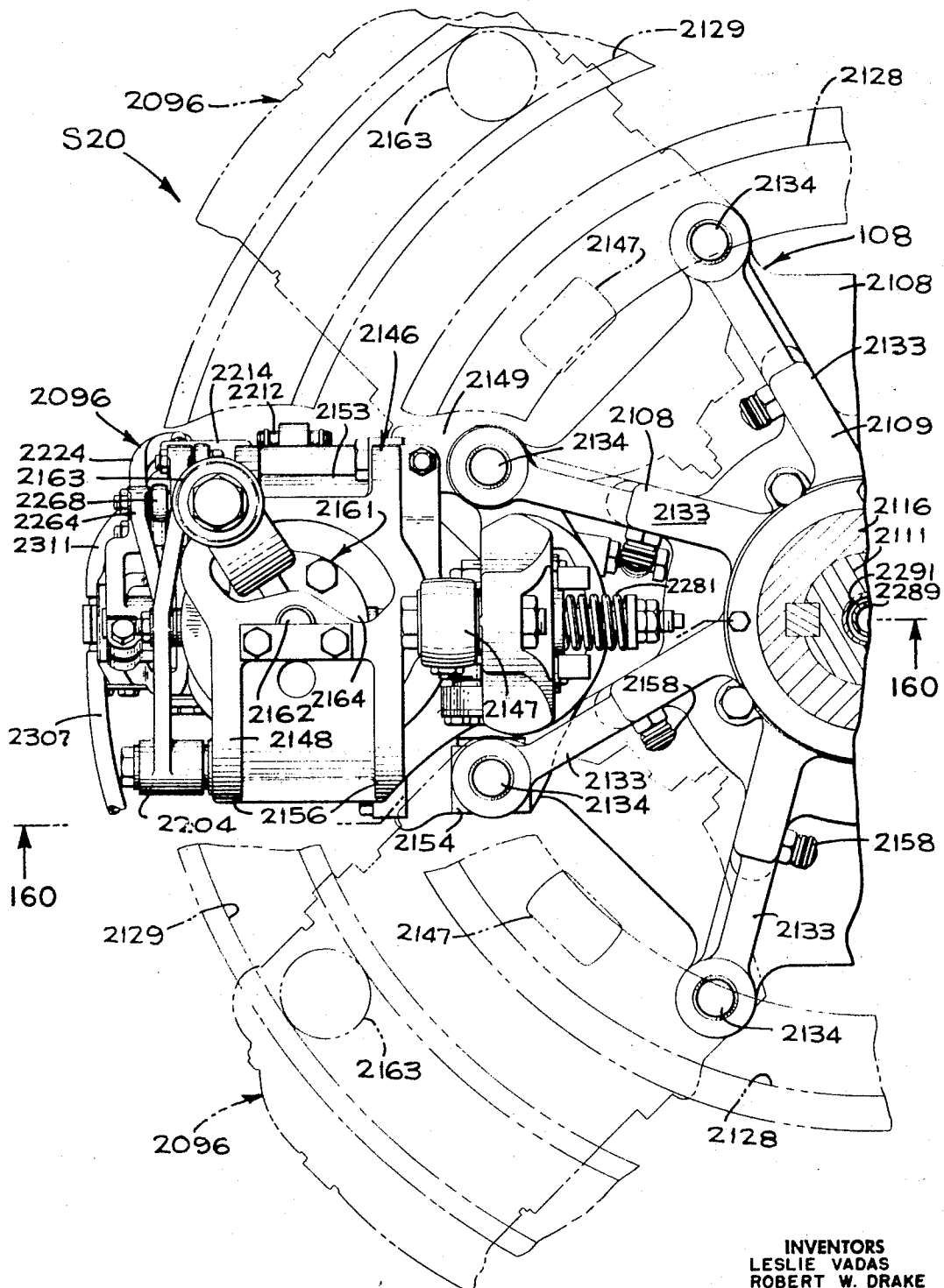
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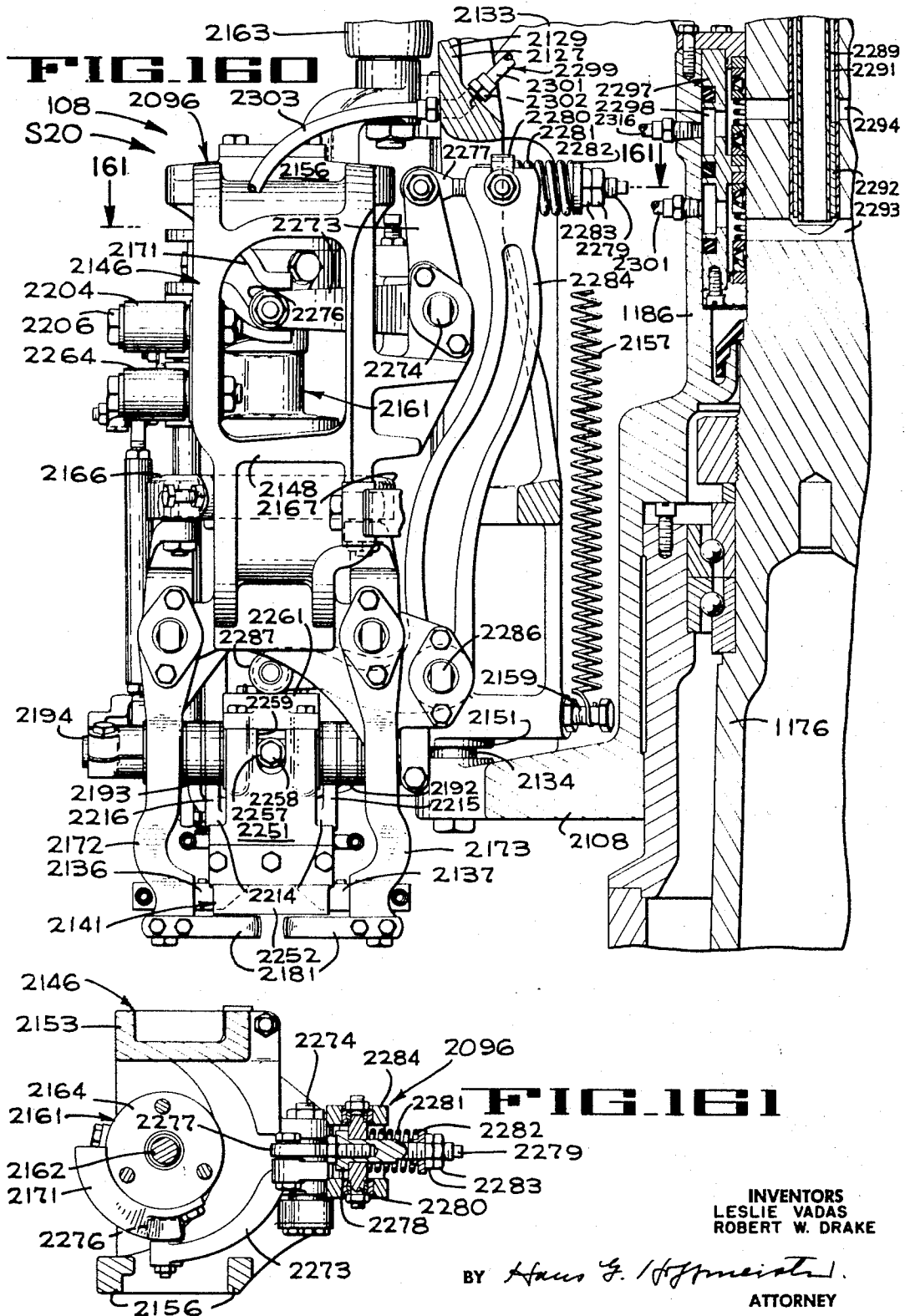
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FIG. 162

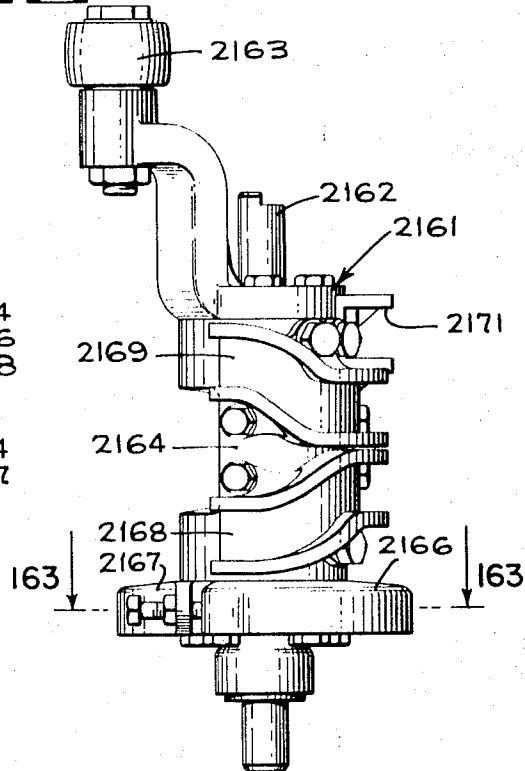


FIG. 164

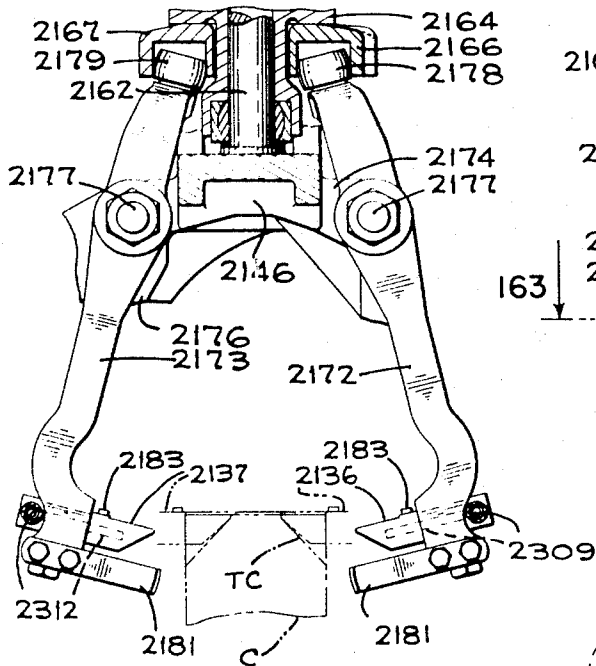
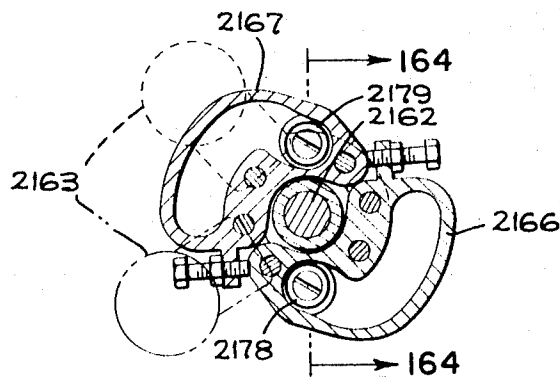


FIG. 163

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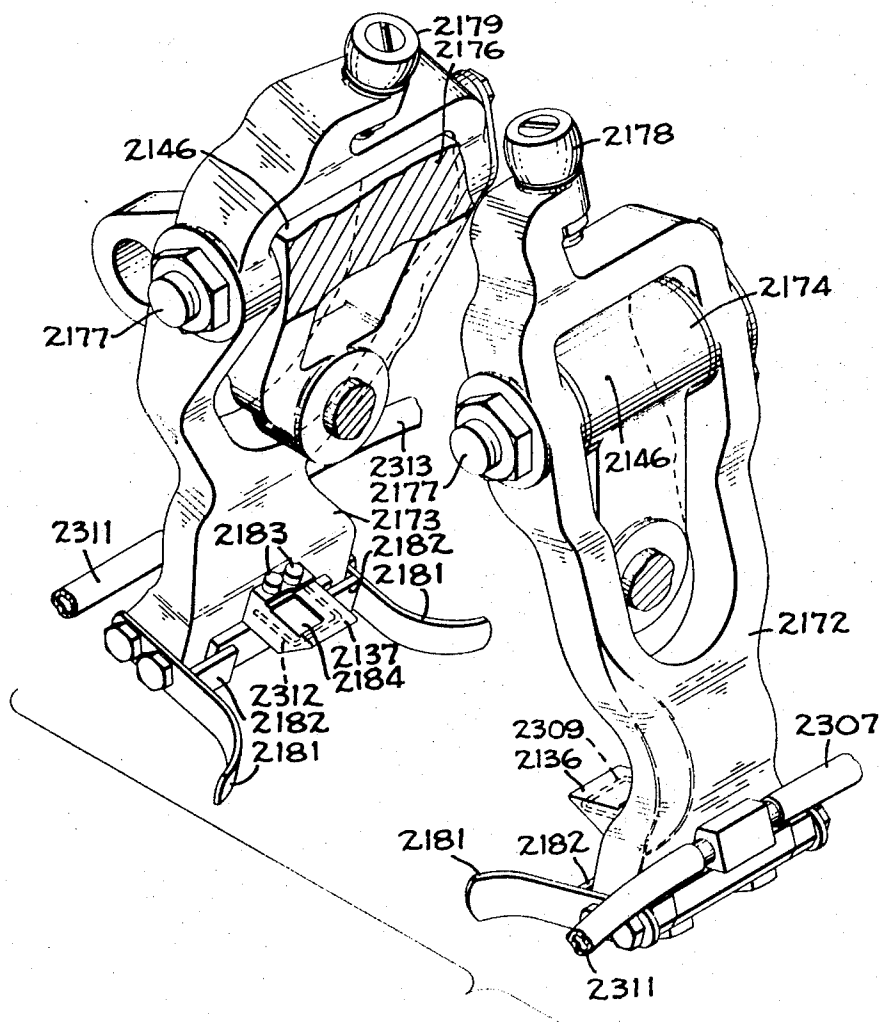


FIG_165

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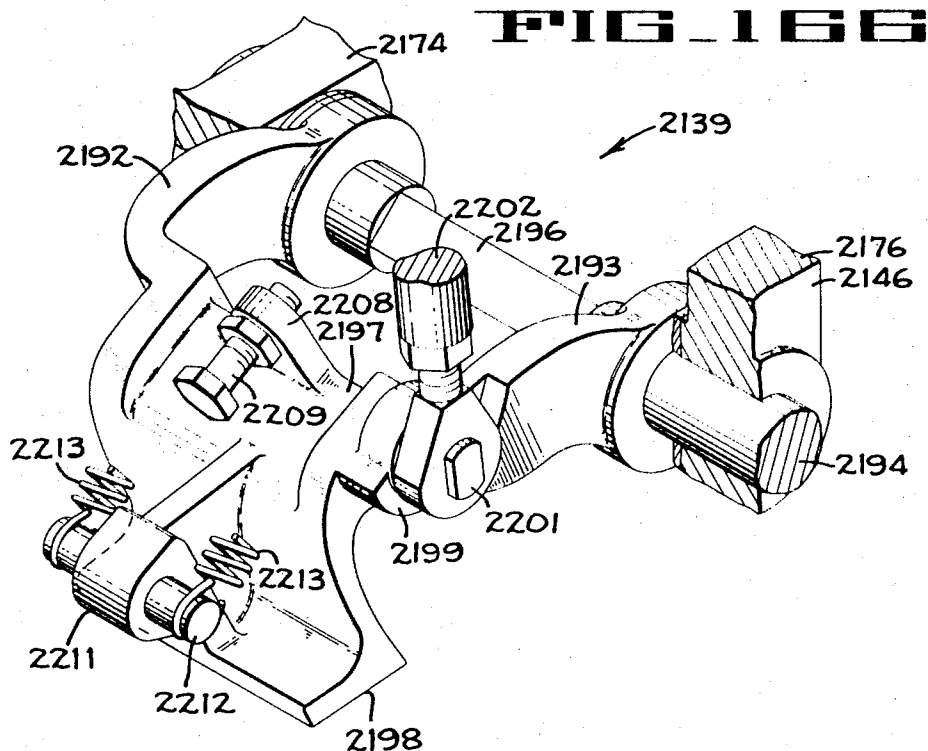
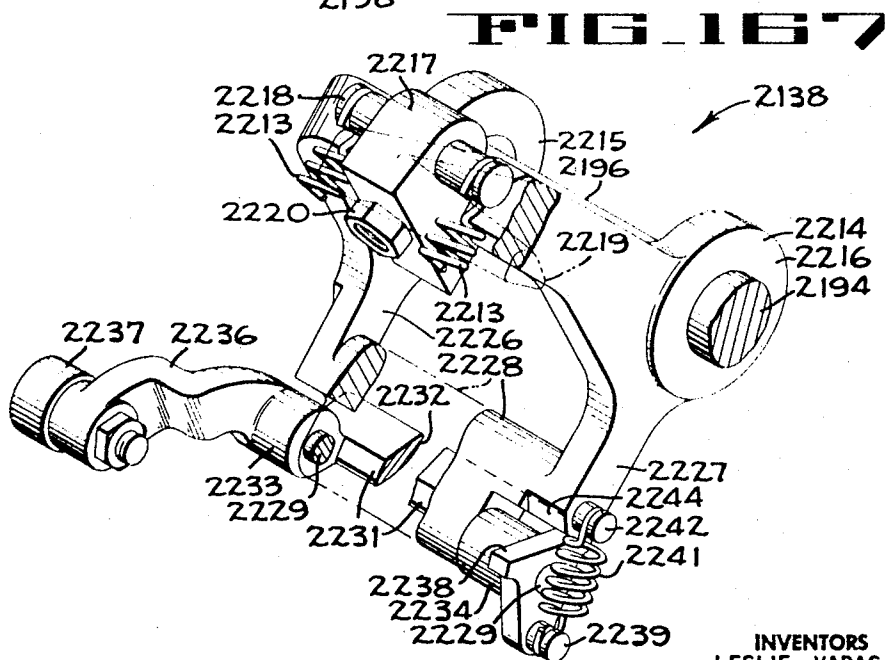
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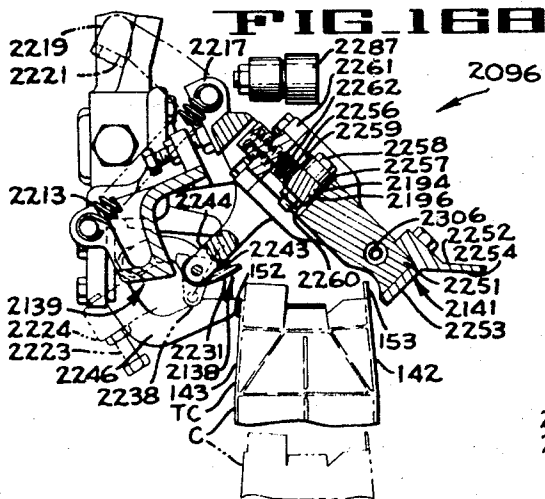
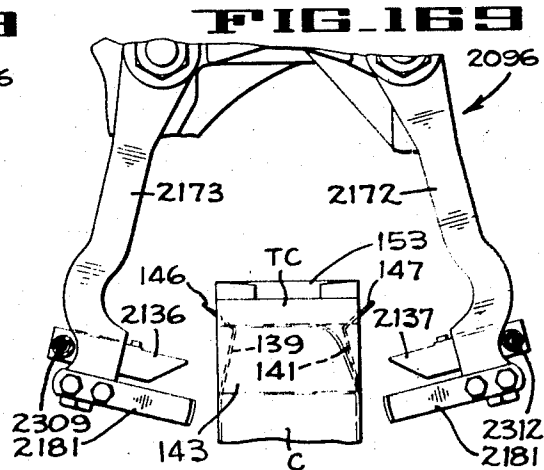
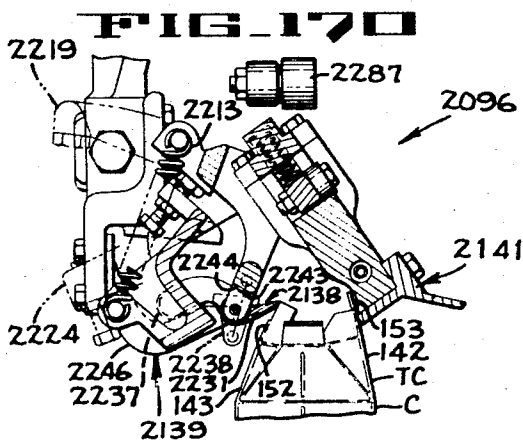
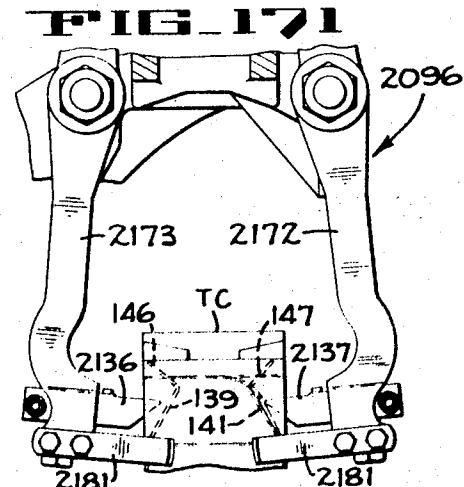
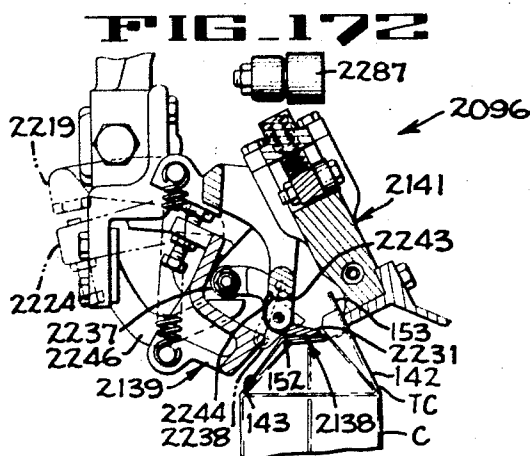
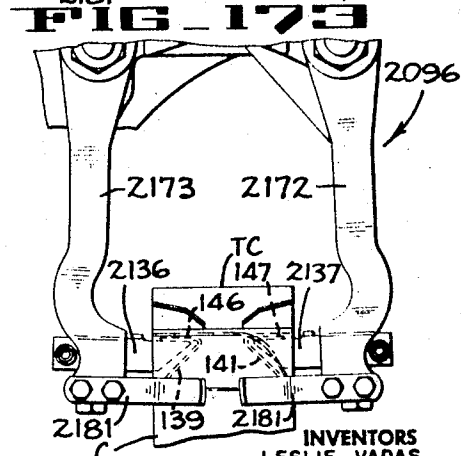
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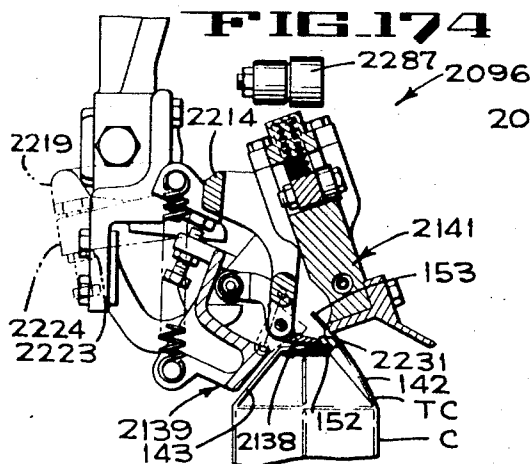
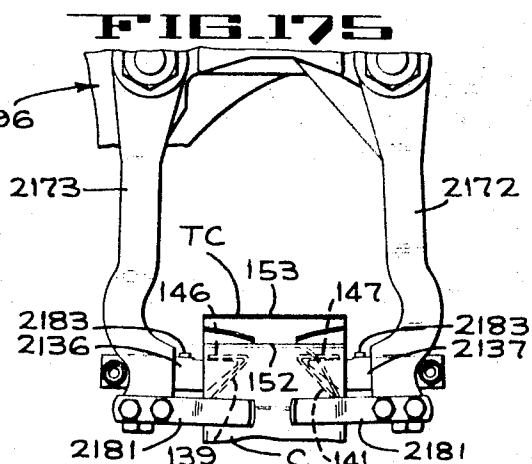
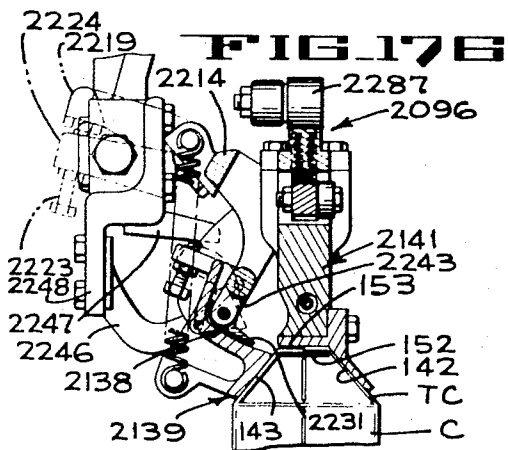
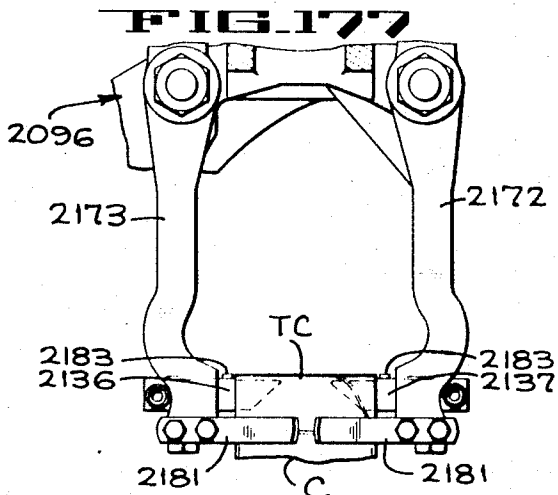
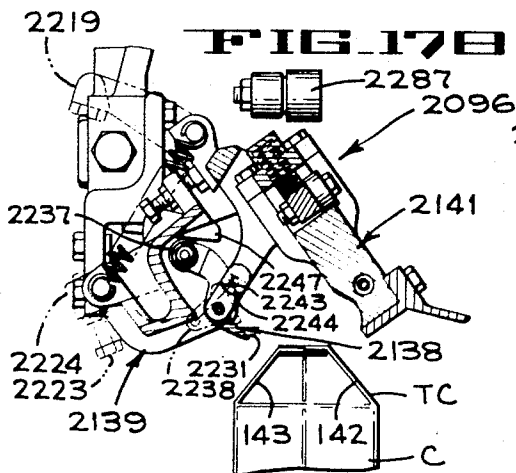
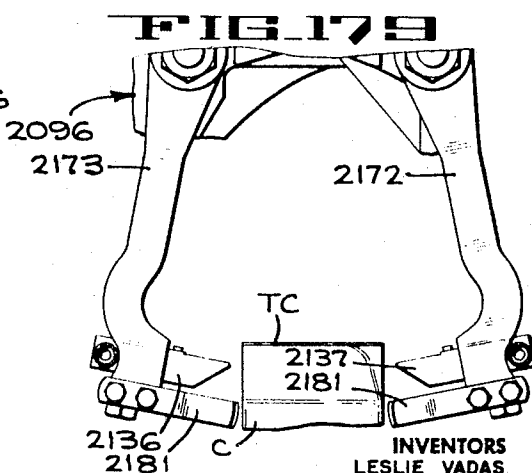
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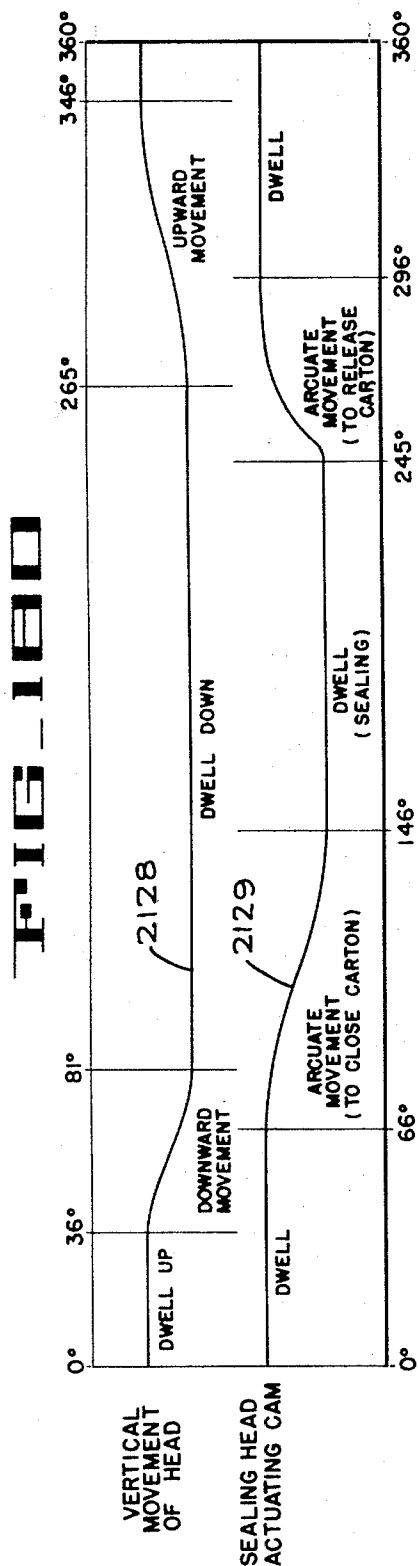
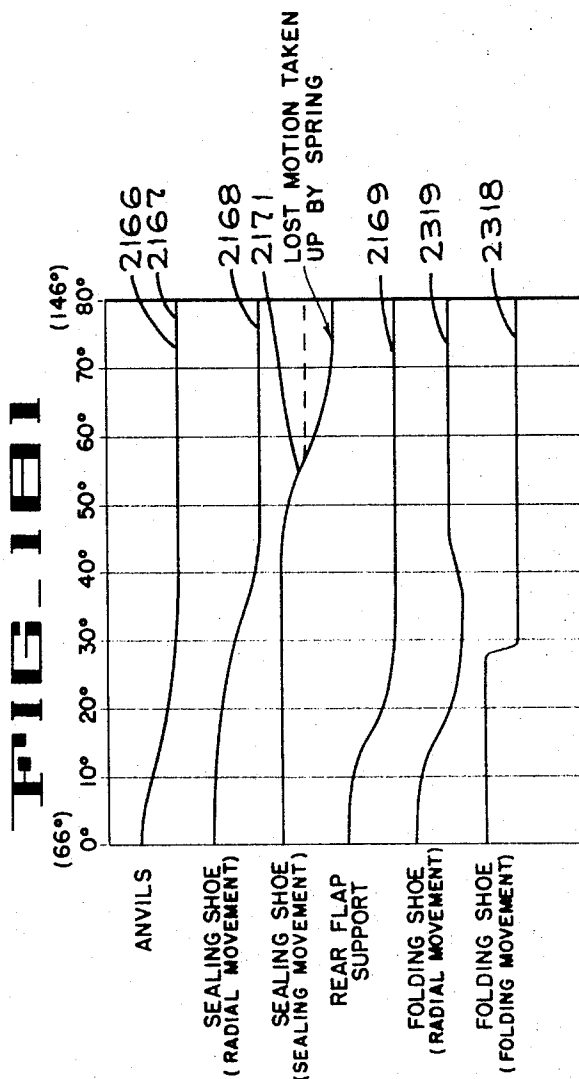
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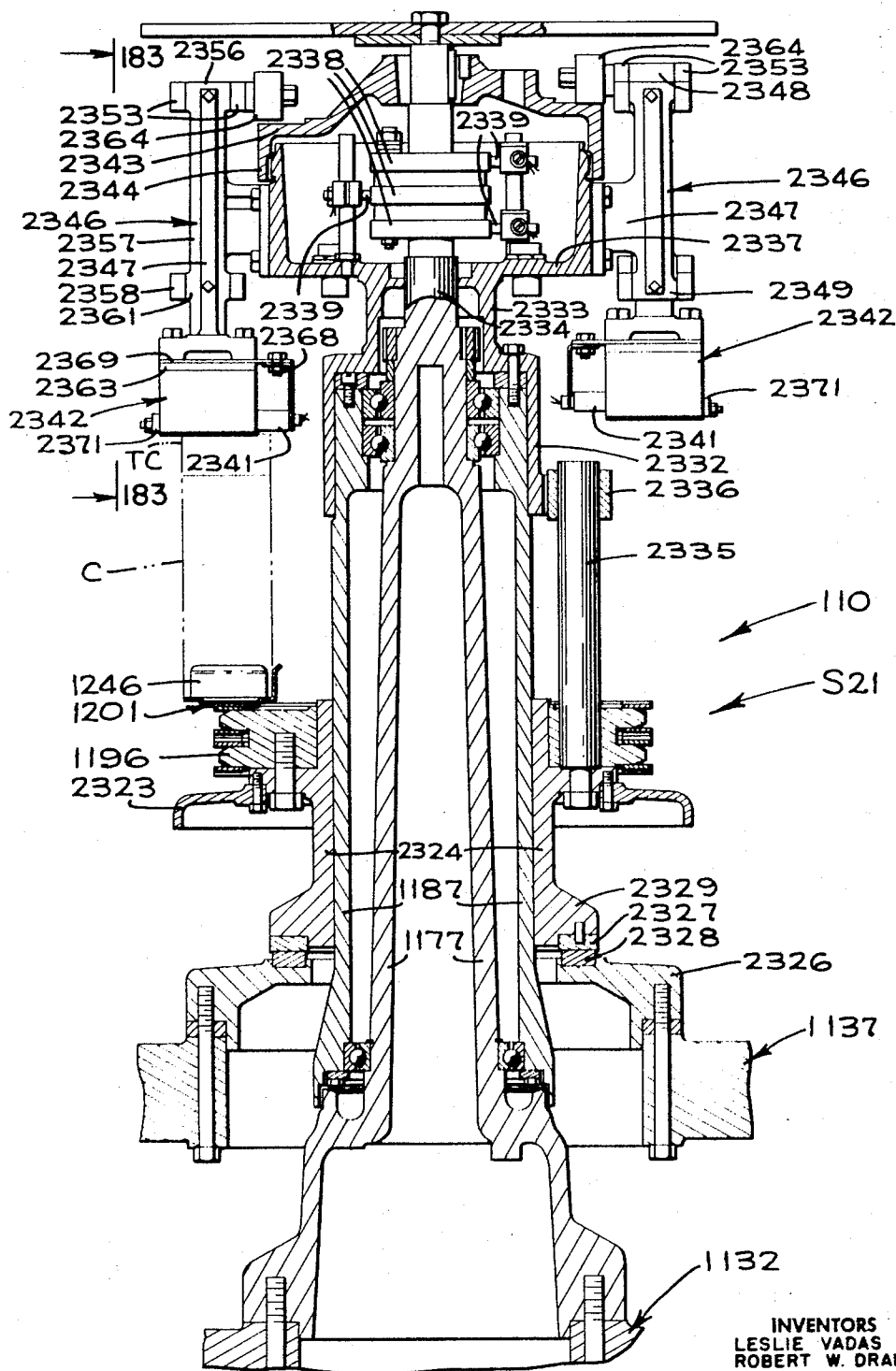


FIG 182

BY *Hans G. Hoffmeister*
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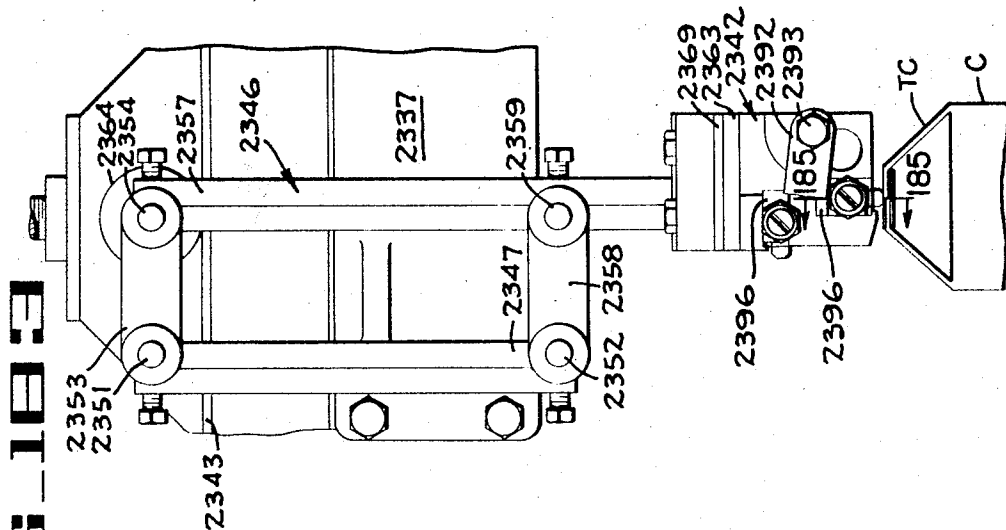
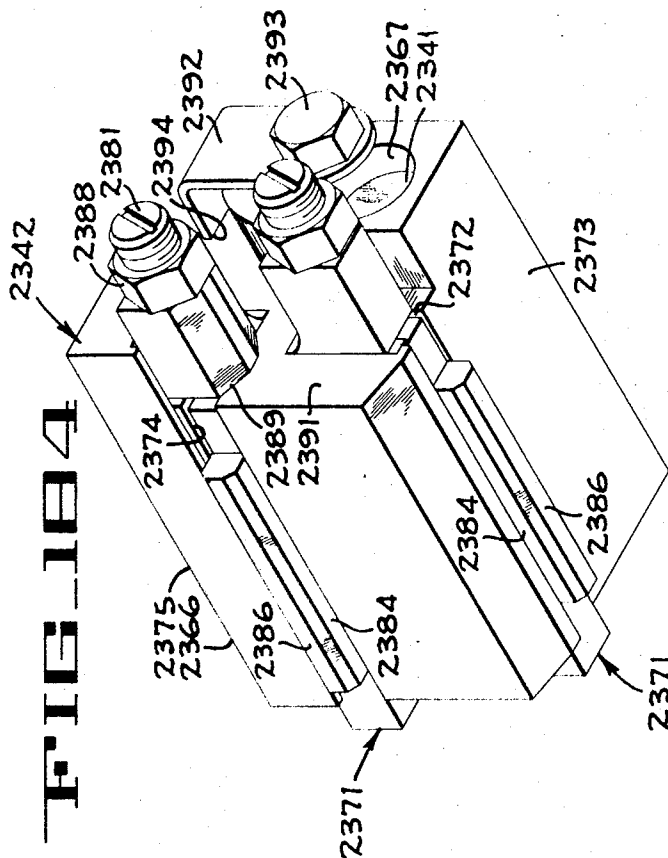
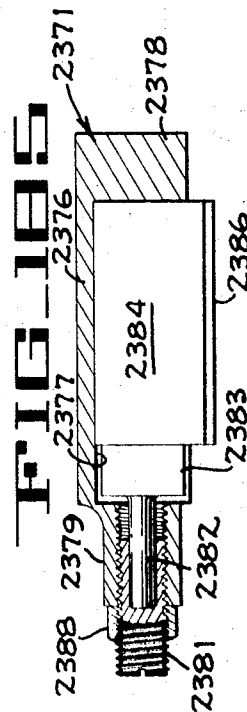
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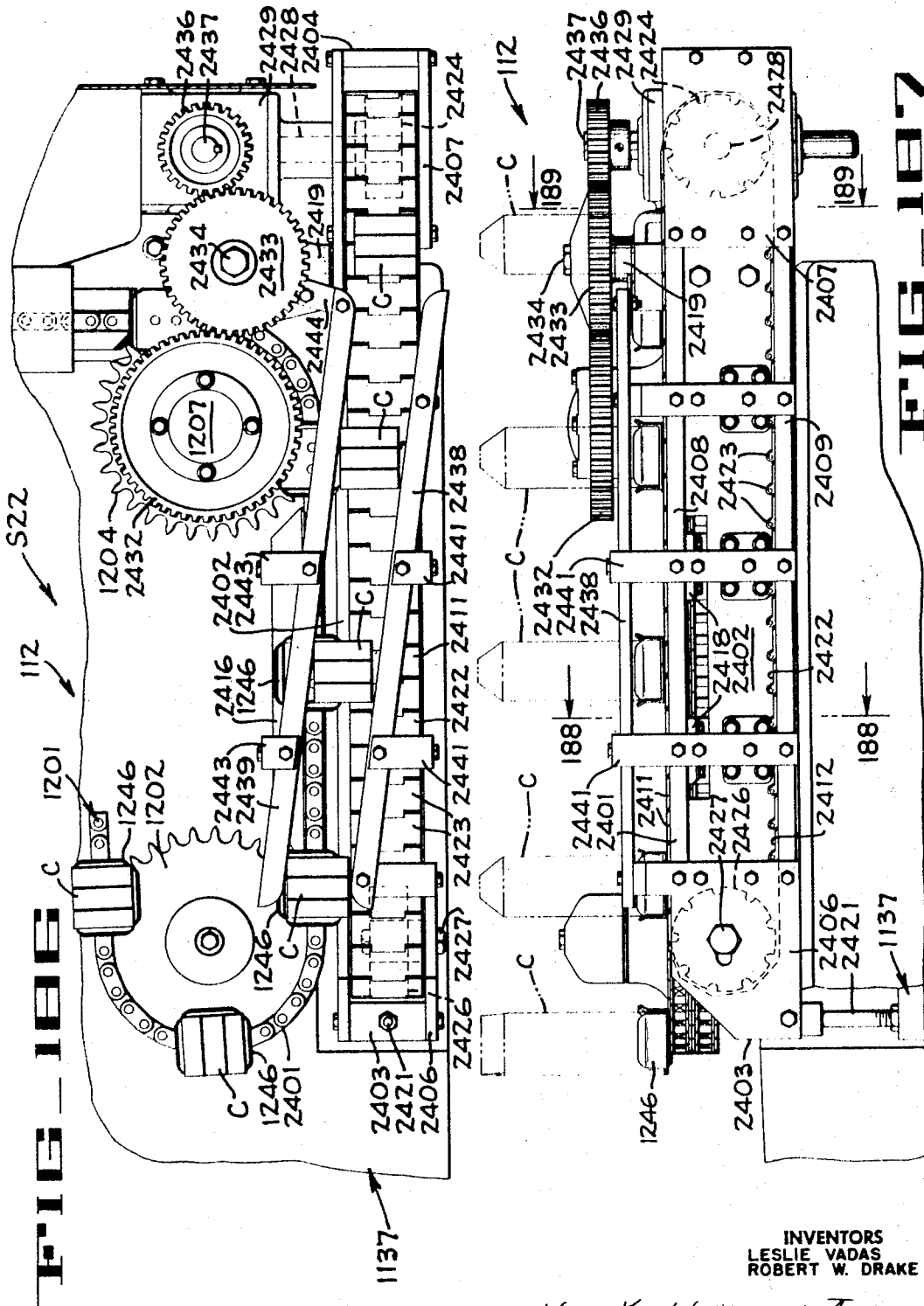
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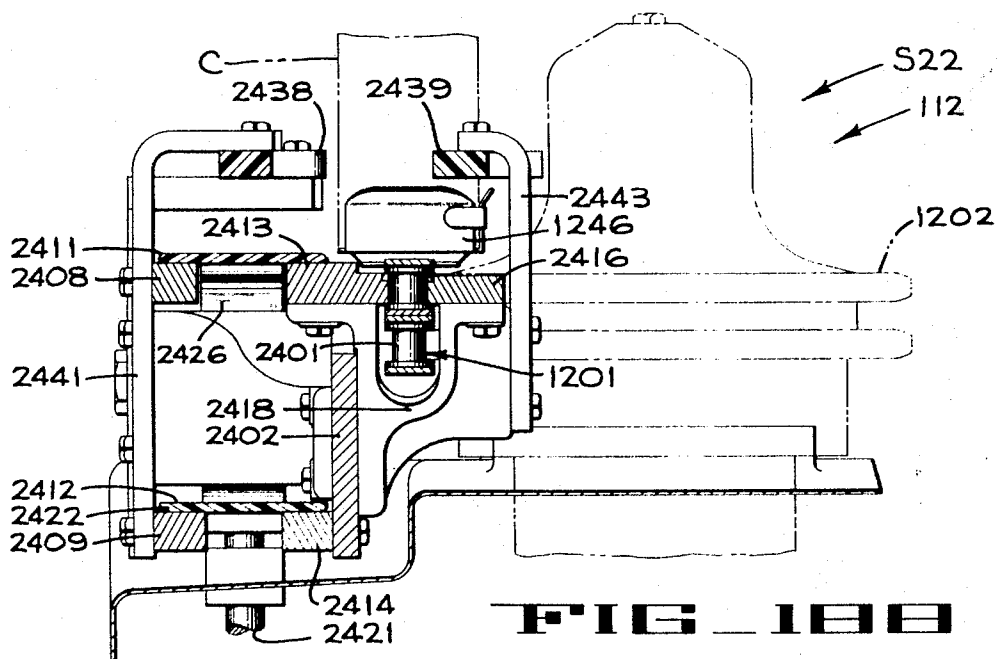
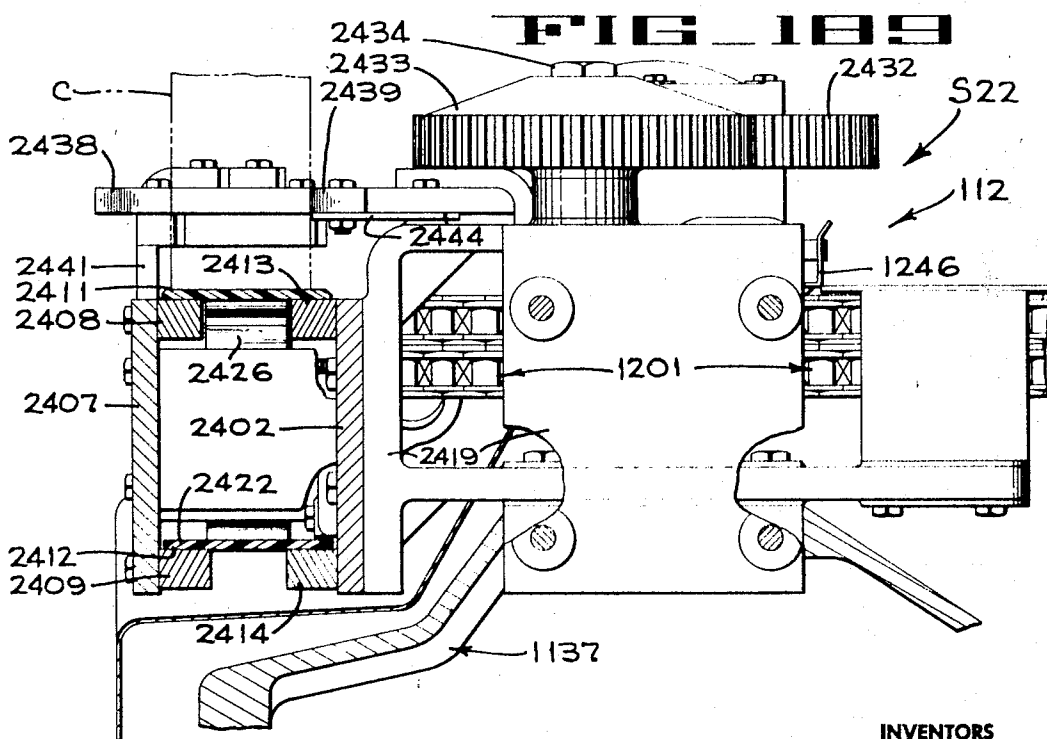
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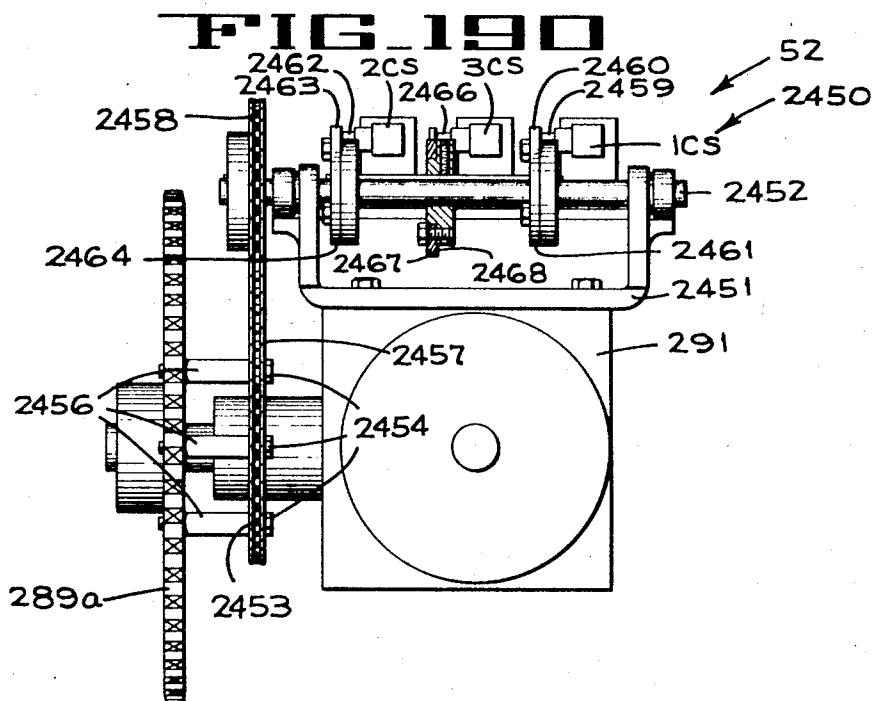
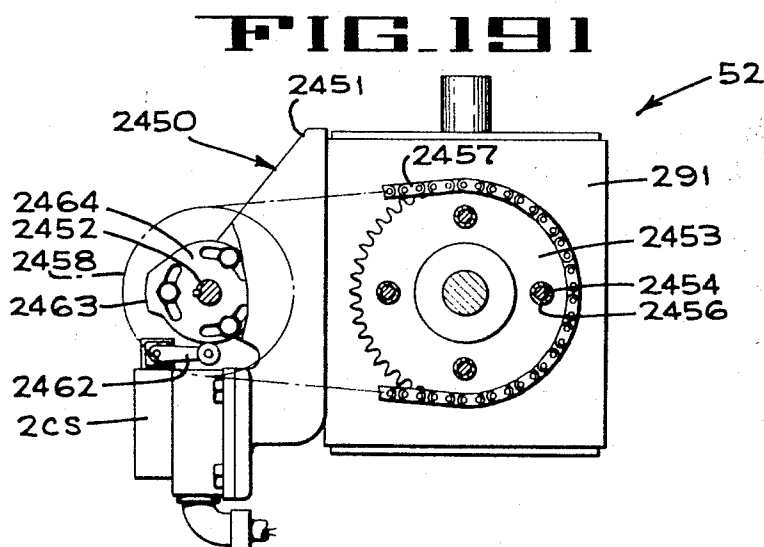
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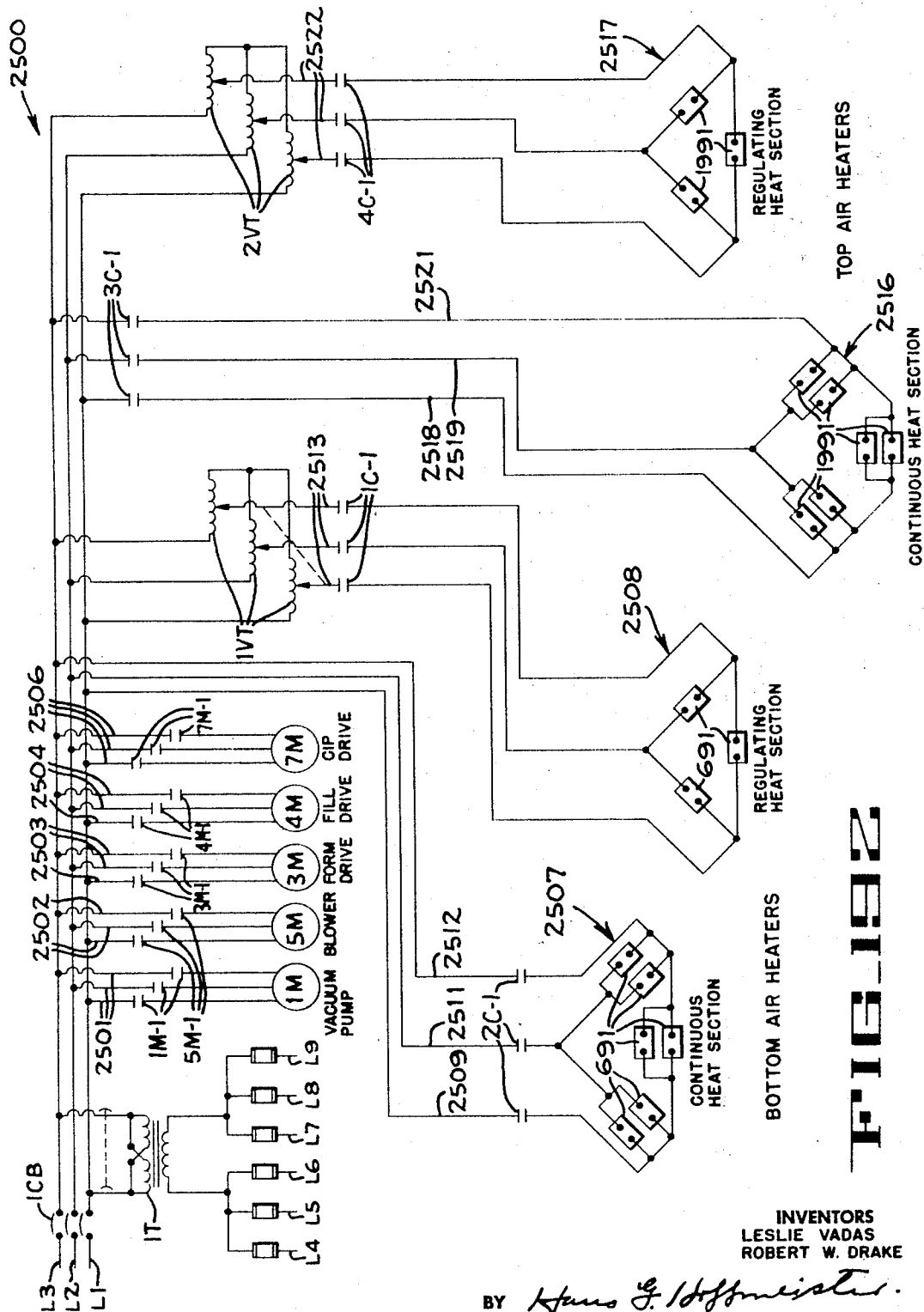


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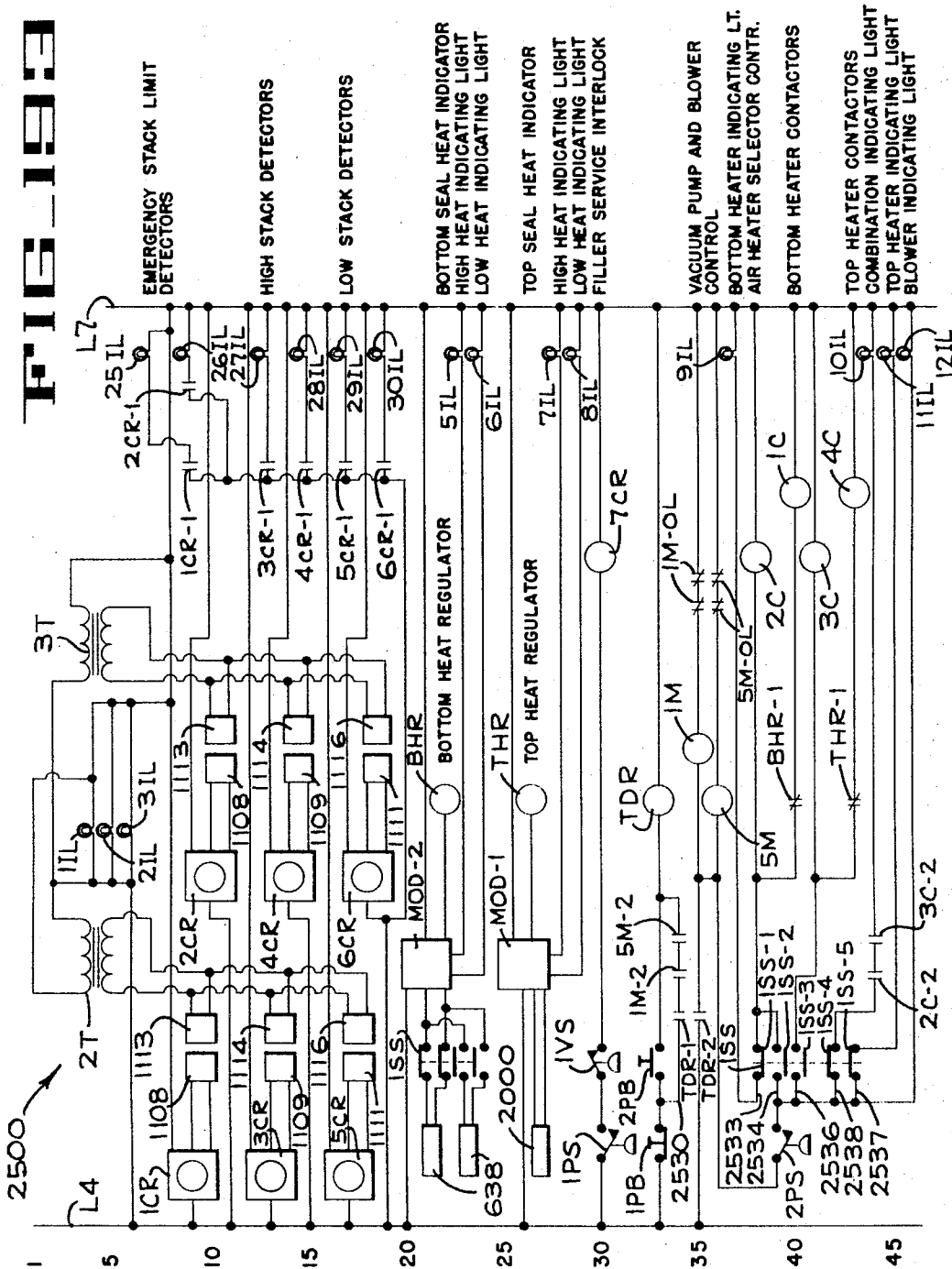
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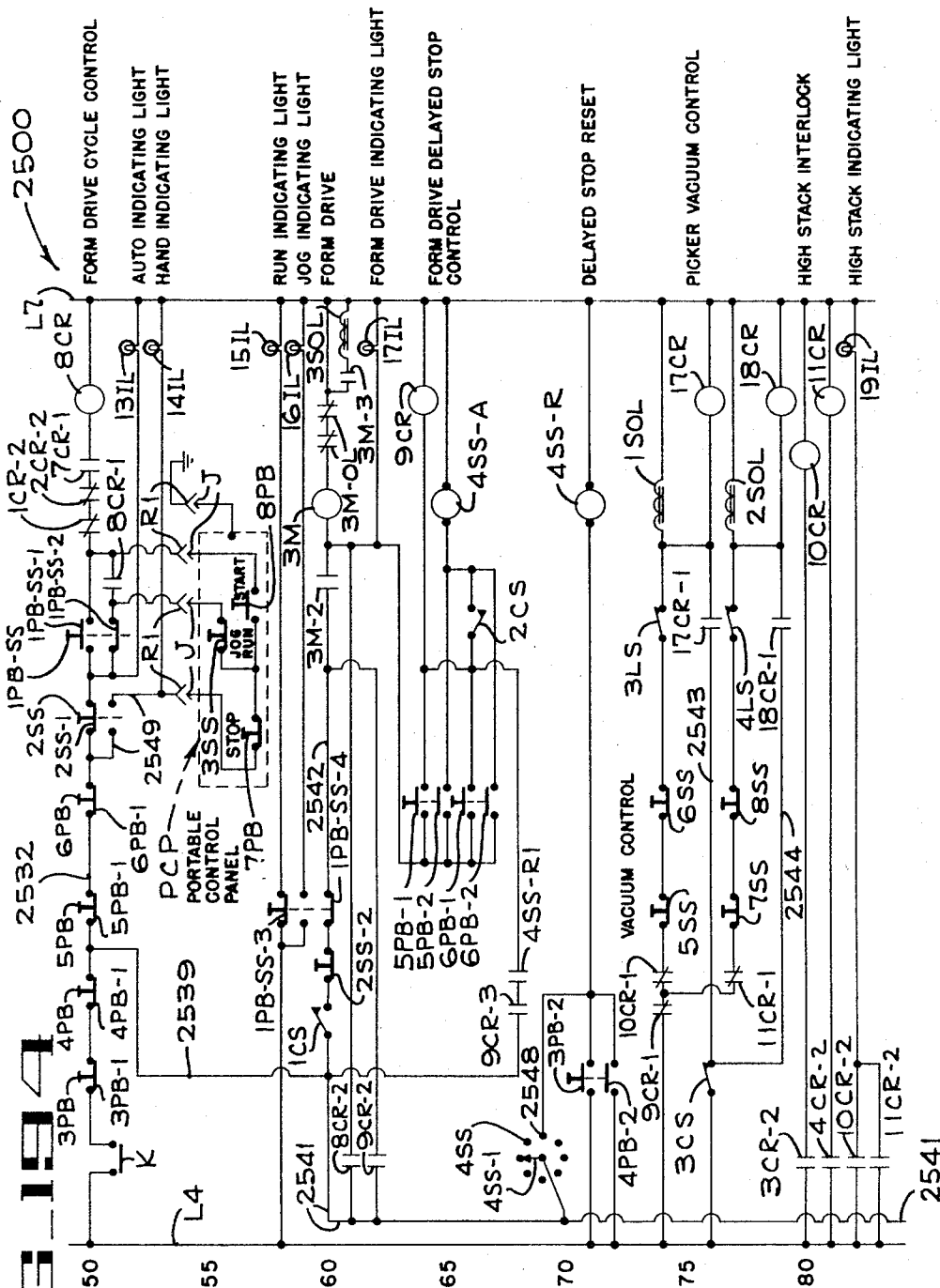
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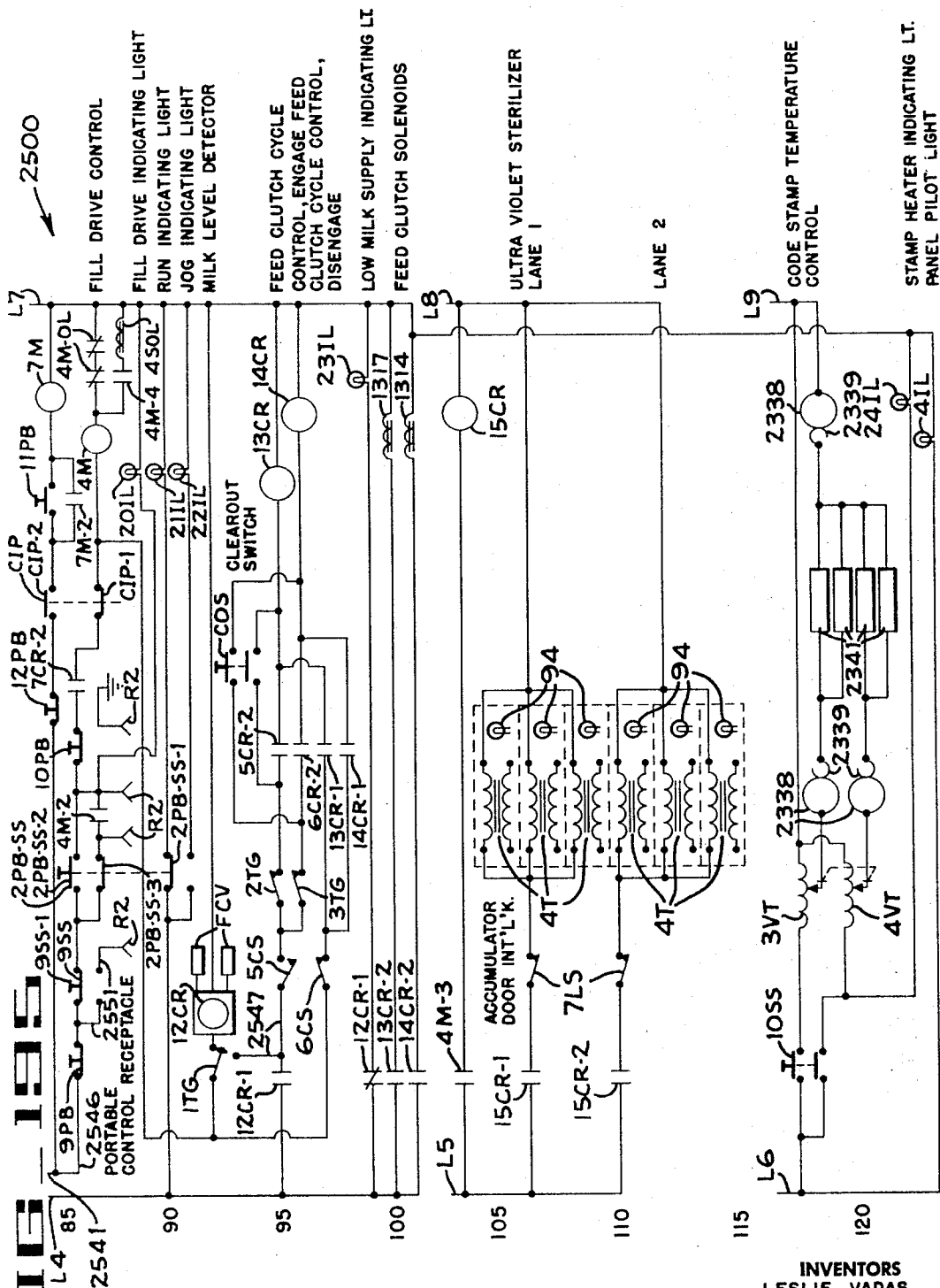
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METHOD AND MACHINE FOR FORMING AND FILLING CARTONS

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Filed June 7, 1965, Ser. No. 461,738

Int. Cl. B65b 43/00, 57/02; B31b 1/76

U.S. Cl. 53—29

37 Claims

ABSTRACT OF THE DISCLOSURE

A machine for forming and filling cartons of different sizes which includes an intermittently driven carton forming section which closes the bottom closure of the cartons, a continuously driven filling section which fills and closes the tops of the cartons and is driven independently of the forming section, and an accumulator disposed between the forming section and filling section which sterilizes the cartons and stores a sufficient number of cartons therein to permit either the fill section, or the form section and accumulator, to operate independently of each other for a limited time. The forming section may be operated so as to clear cartons therefrom when the fill section is inoperative; and conversely, the fill section may be operated when the form section and accumulator are inoperative.

The present invention pertains to packaging machines, and more particularly relates to a machine for forming, sterilizing, filling and sealing cartons of different sizes with a liquid product such as milk.

Dairy products are frequently packaged in cartons of quart, pint, half pint and one-third quart sizes to provide for the varied requirements of the customers. Heretofore, dairies were required to have a separate machine for filling each size of carton, thus making the cost of packaging equipment excessive. This excessive equipment expense was especially true in the case of small dairies.

It has also been determined that it is frequently desirable, when handling heat sealable cartons of the type used in the present machine, to provide means for accumulating a supply of formed cartons between the form section and the fill section so that any temporary interruption of operation of the fill section will permit partially formed cartons already in the form section to be completely formed and moved out of engagement with the heating and bottom closing heads in the form section. If the cartons in the form section were not permitted to progress past the bottom heating stations and the bottom closing stations in the normal manner, it is apparent that the bottom closures of the cartons would not be properly sealed and leakage would occur if the cartons were used.

It is therefore, one object of the present invention to provide a method of and machine for forming, filling and sealing cartons of different sizes.

Another object is to provide a method of and machine for packaging dairy products in cartons wherein a supply of partially formed cartons are accumulated after the bottoms thereof have been sealed and before the product has been filled into the cartons.

Another object is to provide a carton forming and filling machine arranged to intermittently move a plurality of rows of cartons along an arcuate path past a first plurality of processing stations to seal the bottom closures thereof, and thereafter to combine the plurality of rows of cartons into a single row and to continuously move the single row of cartons past a plurality of stations including a carton filling station and a top sealing station.

Another object is to provide a mechanism for erecting and loading collapsed carton blanks onto mandrels

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for subsequent sealing of the bottom forming portions of the cartons.

Another object is to provide a carton erecting and loading mechanism which may be readily adjusted to handle cartons of different sizes.

5 Another object is to provide a mandrel adapted to handle cartons of different sizes.

Another object is to provide an improved device for squaring a collapsed carton blank and for overbending the blank to reduce the inherent resilience therein.

10 Another object is to provide an improved device for loading squared tubular carton blanks onto a mandrel.

Another object is to provide adjustment means for adapting a mandrel to handle cartons of different sizes and to provide means for cooling a mandrel.

15 Another object is to provide a suction head which is readily adjustable to handle either long or short carton blanks.

Another object is to provide an improved bottom forming head.

20 Another object is to provide an improved mechanism for heating the bottom closure flaps of a carton and for controlling air directed into the mechanism.

Another object is to provide an improved flap folding device for folding the bottom flaps of a carton into sealing position.

25 Another object is to provide a two-stage bottom sealing apparatus.

Another object is to provide an improved mechanically actuated linkage for a bottom sealing head.

30 Another object is to provide a carton unloading mechanism adapted to unload cartons of different sizes from the mandrels and to deposit the cartons in positions to be received by an accumulator conveyor.

35 Another object is to provide an accumulating mechanism for sterilizing and thereafter accumulating a supply of sterilized cartons having their bottom closures sealed.

Another object is to provide an accumulating mechanism which is readily adjustable to handle cartons of different sizes.

40 Another object is to provide an apparatus for simultaneously adjusting all components of the fill section to handle cartons of different heights.

Another object is to provide an apparatus for simultaneously adjusting all components of the fill section to handle cartons of different heights and to provide means independent of the adjusting means to control the exact volume of liquid filled into the cartons.

45 Another object is to provide means for loading cartons from two columns of horizontally disposed cartons in an accumulator to a single row of upright cartons.

50 Another object is to provide means for receiving cartons from two columns of cartons in an accumulator and for loading the cartons into a single transport conveyor only when a sufficient quantity of cartons are present in the accumulator.

55 Another object is to provide tab breakers for tearing and bending outwardly tabs on the top closure of a carton.

60 Another object is to provide a mechanically operated top forming turret.

Another object is to provide an improved top forming head.

65 Another object is to provide a no-carton no-fill turret adapted to be adjusted to handle cartons of different heights.

Another object is to provide a filling turret adapted to fill cartons of different sizes.

70 Another object is to provide means for locking a filling head of a filling turret in an elevated inactive position in the event a carton is not present therebelow.

Another object is to provide a filling head which includes a foot valve that may be opened during filling by pressure within the valve.

Another object is to provide a filling valve that includes an in-motion adjustment device which may be adjusted to vary the volume of liquid being filled into a carton while the filling valve is operated.

Another object is to provide a clean-in-place device for cleaning the internal passages of the filling turret without requiring that the turret be disassembled.

Another object is to provide an adjustable cam track. Another object is to provide improved air control means for a top heater.

Another object is to provide an improved top heating head and carton squaring and guiding means therefor.

Another object is to provide a mechanically operated top sealing turret.

Another object is to provide a top sealing head having an improved mechanism for squaring the carton and folding the top closure flaps into sealing position.

Another object is to provide a top sealing turret having a single stationary cam for shifting all the top sealing components of a plurality of top sealing heads into top sealing position.

Another object is to provide a marking turret having a marking head adapted to receive and maintain at operating temperature both an operative marking die and a reserve marking die.

Another object is to provide an improved discharge conveyor for discharging the filled and sealed cartons from the carton forming and filling machine.

These and other objects and advantages of the present invention will become apparent from the following description and the accompanying drawings, in which:

FIGURE 1 is a diagrammatic perspective, with certain parts being cut away, illustrating the carton forming and filling machine of the present invention.

FIGURE 2 is a diagrammatic plan of the machine of FIGURE 1 illustrating the relative positions of the several components of the machine.

FIGURE 3 is a perspective illustrating two sides of a folded carton blank taken looking toward the top closure.

FIGURE 4 is a perspective illustrating the same two sides of the folded carton blank taken looking toward the bottom closure.

FIGURE 5 is a perspective showing the bottom closure of a carton after certain breaking and forming operations have been performed thereon.

FIGURE 6 is a perspective of the completely formed and sealed bottom closure of a carton particularly illustrating certain depressions formed therein for the purpose of blocking any potential leakage passages in the bottom closure.

FIGURE 7 is a perspective showing the four sides of carton which are handled by the machine of the present invention.

FIGURES 8, 9 and 10 are perspectives of the top closure of a carton showing progressive positions of the top closure flaps after certain forming and sealing operations have been performed thereon.

FIGURE 11 is a side elevation showing the top closure of a carton when completely sealed.

FIGURE 12 is an enlarged end elevation looking in the direction of arrows 12—12 of FIGURE 2 illustrating the forming turret and the drive for the carton forming section, certain parts being illustrated in phantom and other parts being removed.

FIGURE 13 is a plan of the drive for the carton forming section, the carton forming turret being illustrated in phantom.

FIGURE 14 is an enlarged horizontal section through the forming turret taken along lines 14—14 of FIGURE 15 and illustrating certain carton forming mechanisms associated with the forming turret.

FIGURE 15 is a vertical section of the forming turret taken along lines 15—15 of FIGURE 14.

FIGURE 16 is an enlarged plan of one of the forming turret mandrels.

FIGURE 17 is an elevation of the mandrel of FIGURE 16 looking in the direction of arrows 17—17 of FIGURE 16.

FIGURE 18 is an end elevation of the mandrel of FIGURE 17 looking in the direction of arrows 18—18 of FIGURE 17.

FIGURE 19 is a section taken along lines 19—19 of FIGURE 17.

FIGURE 20 is a section taken along lines 20—20 of FIGURE 16 illustrating the adjustable carton stop.

FIGURE 21 is a perspective of a portion of the adjustable carton stop.

FIGURE 22 is a side elevation of the upper magazine, certain parts being cut away.

FIGURE 23 is an end view taken looking in the direction of the arrows 23—23 of FIGURE 22, an adjustable guide rail being shown in position to handle quart size carton blanks while a carton pusher is shown in position to handle one-third quart, and half pint size carton blanks.

FIGURE 24 is an elevation taken in the direction of arrows 24—24 in FIGURE 22 showing a fragment of the discharge end of the upper magazine.

FIGURE 25 is a section taken along lines 25—25 of FIGURE 22 illustrating the structure for locking the slide blocks in adjusted position.

FIGURE 26 is an enlarged side elevation of the upper carton erecting mechanism and of the upper loader taken in the direction of arrows 26—26 of FIGURE 2, certain parts being cut away to illustrate operating components of the mechanism.

FIGURE 27 is a plan of the upper carton erecting mechanism and loader of FIGURE 26, certain parts being cut away.

FIGURE 28 is a section taken along lines 28—28 of FIGURE 26.

FIGURE 29 is a vertical section taken substantially along lines 29—29 of FIGURE 28 illustrating the suction head in position to remove a carton from the upper magazine.

FIGURE 30 is a vertical section similar to FIGURE 29 but illustrating the suction head in position for placing a squared carton blank in position to be engaged by the top loader.

FIGURE 31 is an enlarged top plan of the suction head.

FIGURE 32 is an enlarged section taken along lines 32—32 of FIGURE 31 illustrating one of the suction cups.

FIGURE 33 is an enlarged section taken along lines 33—33 of FIGURE 31 illustrating a valve arrangement for adapting the head to handle either quart size cartons or pint, one-third quart and one-half pint size cartons.

FIGURE 34 is a plan of a vacuum control mechanism for the suction heads of the upper and lower carton erecting mechanisms, the orientation of the view in relation to other components of the machine being best illustrated in FIGURE 42.

FIGURE 35 is a vertical section taken along lines 35—35 of FIGURE 34.

FIGURE 36 is an enlarged horizontal section taken along lines 36—36 of FIGURE 35 illustrating the vacuum control mechanism in a cup venting position.

FIGURE 37 is an enlarged vertical section taken along lines 37—37 of FIGURE 36.

FIGURE 38 is a horizontal section similar to FIGURE 36 but illustrating the vacuum control mechanism in a suction applying position.

FIGURE 39 is a vertical section taken along lines 39—39 of FIGURE 38.

FIGURE 40 is a diagrammatic elevation illustrating a carton in several operative positions relative to an over-bending plate as the carton is being moved from the magazine to a position in alignment with the upper loader.

FIGURE 41 is an end elevation of the top loader looking in the direction of arrows 41—41 in FIGURE 27.

FIGURE 42 is a diagrammatic plan illustrating the upper and lower loaders in two operative positions.

FIGURE 43 is a vertical section of the lower carton erecting mechanism and of the lower loader taken substantially along lines 43—43 of FIGURE 2, certain parts being broken away.

FIGURE 44 is a plan of the lower carton erecting mechanism and of the lower loader of FIGURE 43, certain parts being broken away.

FIGURE 45 is a plan of the bottom former illustrating the bottom forming heads in a retracted position.

FIGURE 46 is a vertical section taken along lines 46—46 of FIGURE 45 illustrating in phantom lines the bottom closure of the carton after the bottom forming operation has been performed thereon.

FIGURE 47 is a horizontal section taken along lines 47—47 of FIGURE 46 but illustrating a carton as it appears before being acted upon by the bottom forming head.

FIGURE 48 is a section similar to FIGURE 47 but showing the bottom forming head in the active carton forming position.

FIGURE 49 is a plan of the bottom heater.

FIGURE 50 is a vertical section taken along lines 50—50 of FIGURE 49 illustrating the bottom heating heads in a retracted position.

FIGURE 51 is a horizontal section taken along lines 51—51 of FIGURE 50 illustrating the actuating mechanism for the bottom heating heads.

FIGURE 52 is an enlarged perspective of one of the bottom heating heads shown associated with the bottom closure of a carton.

FIGURE 53 is an enlarged horizontal section taken along lines 53—53 of FIGURE 50 illustrating the bottom closure of a carton in heating position.

FIGURE 54 is a vertical section taken substantially along lines 54—54 of FIGURE 49 and illustrating the structure for heating and controlling the flow of hot air into the bottom heating heads.

FIGURE 55 is a horizontal section with parts broken away taken along lines 55—55 of FIGURE 50 illustrating a flow control valve in its normal operating position.

FIGURE 56 is a horizontal section similar to FIGURE 55 but illustrating the valve in an air diverting position.

FIGURE 57 is an arcuate section taken along line 57—57 of FIGURE 56 illustrating certain passages in the flow control valve.

FIGURE 58 is an elevation of the bottom folding roller plows taken looking in the direction of arrows 58—58 in FIGURE 2.

FIGURE 59 is a horizontal section taken along line 59—59 of FIGURE 58.

FIGURE 60 is an enlarged vertical section taken along lines 60—60 of FIGURE 58 illustrating the manner in which the bottom closure flaps enter the roller plow.

FIGURE 61 is a vertical section taken along lines 61—61 of FIGURE 59 said vertical section being illustrated on the same sheet as FIGURE 58.

FIGURE 62 is a vertical section taken along lines 62—62 of FIGURE 59, said vertical section being illustrated on the same sheet as FIGURE 58.

FIGURE 63 is a plan with certain parts cut away illustrating the preliminary and final bottom sealers in the inactive positions.

FIGURE 64 is a vertical section taken along lines 64—64 of FIGURE 63.

FIGURE 65 is a vertical section taken along lines 65—65 of FIGURE 63.

FIGURE 66 is a horizontal section taken along lines 66—66 of FIGURE 4 illustrating the preliminary sealing head in an active sealing position.

FIGURE 67 is a vertical section taken along lines 67—67 of FIGURE 63 illustrating a portion of the actuating mechanism for the sealing heads.

FIGURE 68 is an enlarged perspective of the press plate for the preliminary sealing head, the position of the bottom closure of a carton relative thereto being illustrated in phantom lines.

FIGURE 69 is an enlarged perspective of the press plate for the final sealing head.

FIGURE 70 is an enlarged vertical section taken along lines 70—70 of FIGURE 63 illustrating the final sealing head in sealing position against the bottom closure of a carton.

FIGURE 71 is a vertical section taken along lines 71—71 of FIGURE 70 illustrating a portion of the mandrel and the internal surface of the bottom closure.

FIGURE 72 is a perspective of the sealed bottom closure of a carton illustrating certain indented areas arranged to block potential flow passages in the sealed bottom closure.

FIGURE 73 is a plan illustrating the mandrel unloading mechanism in the retracted position with the mechanism being adjusted to handle quart size cartons.

FIGURE 74 is a side elevation of the unloader taken looking in the direction of arrows 74—74 of FIGURE 73, certain parts being cut away.

FIGURE 75 is a vertical section taken along lines 75—75 of FIGURE 74 illustrating the accumulator conveyor loading rotors.

FIGURE 76 is a vertical section taken substantially along lines 76—76 of FIGURE 75 illustrating the mandrel unloading mechanism in an extended position.

FIGURE 77 is a vertical section taken along lines 77—77 of FIGURE 73 illustrating the mandrel unloading carrier.

FIGURE 78 is a vertical section taken along lines 78—78 of FIGURE 73 illustrating the carton transfer carrier.

FIGURE 79 is an enlarged vertical section taken along lines 79—79 of FIGURE 73 illustrating the mandrel unloader in its retracted position relative to a carton on the mandrel.

FIGURE 80 is an enlarged vertical section taken along lines 80—80 of FIGURE 79.

FIGURE 81 is an enlarged vertical section taken along lines 81—81 of FIGURE 79 illustrating one of the carton engaging stripper fingers.

FIGURE 82 is a vertical section taken along lines 82—82 of FIGURE 2 illustrating the sterilizing and accumulating mechanisms.

FIGURE 83 is a perspective illustrating a portion of the accumulator loading mechanism and the mandrel unloader with the parts being arranged to handle one-third quart carton, certain parts of the accumulator being removed.

FIGURE 84 is an enlarged horizontal section taken along lines 84—84 of FIGURE 82.

FIGURE 85 is an enlarged horizontal section taken along lines 85—85 of FIGURE 82.

FIGURE 86 is an enlarged elevation looking in the direction of arrows 86—86 of FIGURE 82, certain parts being broken away.

FIGURE 87 is a vertical section taken along lines 87—87 of FIGURE 86 illustrating certain carton guiding tracks.

FIGURE 88 is a vertical section taken along lines 88—88 of FIGURE 86.

FIGURE 89 is an enlarged elevation looking in the direction of arrows 89—29 of FIGURE 82, certain parts being broken away.

FIGURE 90 is a perspective illustrating certain sta-

tionary and movable carton guiding tracks of the accumulator.

FIGURE 91 is a horizontal section of the filling section taken along lines 91—91 of FIGURE 92 illustrating the turret placement and drive arrangement, certain parts being cut away.

FIGURE 92 is a side elevation of the lower portion of the filling section illustrated in FIGURE 91, certain parts being removed.

FIGURE 93 is an end elevation of the lower portion of the filling section illustrated in FIGURE 91, certain parts being cut away.

FIGURE 94 is an enlarged perspective of a portion of the carton transport conveyor of the filling section illustrating one of the carton carriers.

FIGURE 95 is an enlarged elevation looking in the direction of arrows 95—95 of FIGURE 2 illustrating the carton transfer mechanism and the crimping turret.

FIGURE 96 is an elevation of the transfer mechanism looking in the direction of arrows 96—96 of FIGURE 95.

FIGURE 97 is an enlarged horizontal section taken along lines 97—97 of FIGURE 95 illustrating the actuating mechanism for the carton transfer arms.

FIGURE 98 is an enlarged horizontal section taken along lines 98—98 of FIGURE 95 illustrating the lower carton transfer arms.

FIGURE 99 is an enlarged horizontal section taken along lines 99—99 of FIGURE 95 illustrating the manner in which the cartons are transferred into position to be received by the crimping turret.

FIGURE 100 is a vertical section of the crimping turret taken substantially along lines 100—100 of FIGURE 99.

FIGURE 101 is an enlarged horizontal section taken along lines 101—101 of FIGURE 100 illustrating the structure for pivoting the pick-up fingers.

FIGURE 102 is an elevation of one of the crimping assemblies taken looking in the direction of arrows 102—102 in FIGURE 100 and illustrating the crimping head in two operative positions.

FIGURE 103 is an enlarged elevation of one of the crimping heads shown in an elevated position relative to a carton prior to crimping.

FIGURE 104 is an enlarged vertical section taken along lines 104—104 of FIGURE 102 illustrating the crimping head in crimping position within the top closure of a carton.

FIGURE 105 is an enlarged perspective of a crimping head and the top closure of a carton after the carton has been crimped.

FIGURES 106 and 107 are operational views illustrating the operative relationship between the crimping head, the pick-up fingers and the dead plate.

FIGURE 108 is a vertical section taken substantially along lines 108—108 of FIGURE 2 illustrating the top forming turret 100.

FIGURE 109 is an enlarged vertical section taken substantially along lines 109—109 of FIGURE 108 illustrating the conical anvil and the top forming head in their uppermost position.

FIGURES 110 and 111 are operational views similar to FIGURE 109 illustrating the anvil and top forming heads in different operative positions.

FIGURE 112 is an enlarged vertical section taken along lines 112—112 of FIGURE 111.

FIGURE 113 is a vertical section taken along lines 113—113 of FIGURE 112.

FIGURE 114 is an enlarged perspective of a portion of the forming head, the conical anvil being cut away.

FIGURE 115 is a plan of the no-carton no-fill turret indicating the relationship between the no-carton no-fill turret and the filling turret.

FIGURE 116 is a vertical section taken substantially along lines 116—116 of FIGURE 115.

FIGURE 117 is a horizontal section taken along lines 117—117 of FIGURE 116.

FIGURE 118 is a horizontal section taken along lines 118—118 of FIGURE 116.

FIGURES 119A and 119B are vertical sections taken along lines 119—119 of FIGURE 115 and when combined illustrate the filling turret, certain parts being removed.

FIGURE 120 is an elevation of a portion of the filling turret illustrating one of the filling heads.

FIGURE 121 is a vertical section with parts broken away taken along lines 121—121 of FIGURE 120.

FIGURE 122 is an enlarged horizontal section taken along lines 122—122 of FIGURE 121.

FIGURE 123 is an enlarged vertical section of a portion of the filling head illustrated in FIGURE 120 taken along the lines 123—123 of FIGURE 124 and showing a cylinder locking device that is controlled by the no-carton no-fill device in two operative positions.

FIGURE 124 is a horizontal section taken along lines 124—124 of FIGURE 121.

FIGURE 125 is a vertical section taken substantially along lines 125—125 of FIGURE 124, certain parts being cut away.

FIGURE 126 is an enlarged horizontal section taken substantially along the lines 126—126 of FIGURE 119A and illustrating an adjustable cam and parts of an in-motion adjustment mechanism.

FIGURE 127 is a vertical section of the adjustable cam taken along lines 127—127 of FIGURE 126.

FIGURE 128 is a section taken along lines 128—128 of FIGURE 126 illustrating a tongue and groove connection.

FIGURE 129 is an enlarged vertical section illustrating a portion of the in-motion adjustment mechanism and a portion of the clean-in-place mechanism.

FIGURE 130 is a view similar to FIGURE 129 but illustrating the clean-in-place mechanism in a different operative position.

FIGURE 131 is an enlarged vertical section taken along lines 131—131 of FIGURE 132 illustrating a conveyor unlatching device.

FIGURE 132 is an elevation of the conveyor unlatching device taken looking in the direction of arrows 132—132 of FIGURE 119B.

FIGURE 133 is an enlarged horizontal section taken substantially along lines 133—133 of FIGURE 119B illustrating a portion of the clean-in-place mechanism.

FIGURE 134 is a vertical section taken along lines 134—134 of FIGURE 133.

FIGURE 135 is a vertical section taken along lines 135—135 of FIGURE 133.

FIGURES 136 to 144 are operational views of the filling heads illustrating progressive steps in one cycle of operation of the filling heads.

FIGURE 145 is a diagram of the cams which control the operation of the filling head.

FIGURE 146 is a vertical section taken along lines 146—146 of FIGURE 2 illustrating the top heating turret.

FIGURE 147 is a vertical section taken along lines 147—147 of FIGURE 146.

FIGURE 148 is a plan of the top heating turret of FIGURE 146.

FIGURE 149 is a horizontal section taken substantially along lines 149—149 of FIGURE 146 illustrating an air control valve in a normal operating position.

FIGURE 150 is a section similar to FIGURE 149 but showing the valve in an air venting position.

FIGURE 151 is a vertical arcuate section taken along lines 151—151 of FIGURE 150.

FIGURE 152 is an enlarged elevation with parts broken away illustrating one of the top heating heads in an operative position relative to a carton, said view being taken looking in the direction of arrows 152—152 of FIGURE 146.

FIGURE 153 is an enlarged section of the top heating head taken along lines 153—153 of FIGURE 152.

FIGURE 154 is a section taken along lines 154—154 of FIGURE 153.

FIGURE 155 is an enlarged, exploded perspective of the top heating head.

FIGURE 156 is a vertical section of the top sealing turret taken substantially along the lines 156—156 of FIGURE 2.

FIGURE 157 is an enlarged side elevation of one of the top sealing heads of FIGURE 156 taken looking in the direction of arrows 157—157 of FIGURE 156, certain parts being cut away.

FIGURE 158 is an elevation similar to FIGURE 157 but having certain operative components of the sealing head removed so as to illustrate the sealing head carrier.

FIGURE 159 is a plan illustrating one of the sealing heads mounted on the turret and showing the locations of the adjacent sealing heads in phantom.

FIGURE 160 is a vertical section taken substantially along lines 160—160 of FIGURE 159 illustrating the linkages for exerting a sealing pressure on the sealing shoe.

FIGURE 161 is a horizontal section taken along lines 161—161 of FIGURE 160 illustrating a lost motion connection in the pressure applying linkage.

FIGURE 162 is an elevation of a multiple faced cam which controls the operation of the several top sealing components which contacts the carton.

FIGURE 163 is a vertical section taken along lines 163—163 of FIGURE 162 illustrating anvil controlling cam tracks and the arcuate range of travel of the multiple faced cam.

FIGURE 164 is a vertical section taken substantially along lines 164—164 of FIGURE 163 illustrating the anvils and their supporting mechanisms in two operative positions.

FIGURE 165 is a perspective of the anvils and their supporting mechanism, certain parts being cut away.

FIGURE 166 is a perspective of the rear flap support.

FIGURE 167 is a perspective of the folding shoe and folding shoe foot, certain parts being cut away and other parts being shown in phantom.

FIGURES 168—169, 170—171, 172—173, 174—175, 176—177, and 178—179 are pairs of operational views which illustrate progressive stages in the operation of each top sealing head, one view of each pair of views showing the mechanism that operates on the front and rear elements of the top closure and the other view showing the mechanism that operates on the side elements of the closure.

FIGURE 180 is a cam diagram illustrating the contour of a pair of turret cam tracks.

FIGURE 181 is a cam diagram of the multiple faced cam illustrating the operative relationship of several components controlled by the multiple faced cam.

FIGURE 182 is a vertical section of the marking turret taken along the lines 182—182 of FIGURE 2.

FIGURE 183 is an enlarged elevation taken in the direction of arrows 183—183 of FIGURE 182.

FIGURE 184 is an enlarged perspective of the marking head.

FIGURE 185 is a vertical section of one of the marking dies taken along lines 185—185 of FIGURE 183.

FIGURE 186 is a plan of the discharge conveyor.

FIGURE 187 is a side elevation of the discharge conveyor of FIGURE 186.

FIGURE 188 is a vertical section along lines 188—188 of FIGURE 187.

FIGURE 189 is a vertical section taken along lines 189—189 of FIGURE 187.

FIGURE 190 is a top plan of a cycle timer, the orientation of the timer relative to other components of the machine being best shown in FIGURE 13.

FIGURE 191 is a side elevation of the timer of FIGURE 190.

FIGURES 192—195, when combined, form an electrical

wiring diagram which controls the operation of the carton forming and filling machine.

Although the cartons handled by this machine are not a part of the present invention, it is to be understood that the cartons are made of a thermoplastic laminate, including a laminated cardboard inner base layer with a polyethylene coating on both the outside and the inside of the base layer. The transverse cross-section of the bottom closures and of the top closures of each of the referred to carton sizes, i.e., the quart, one-third quart, pint and half pint sizes, are identical and only the height of the carton varies. It is to be understood, that the machine may be easily modified to handle cartons of other capacities.

GENERAL DESCRIPTION

The carton forming and filling machine 50 (FIGS. 1 and 2) of the present invention is arranged to receive folded carton blanks B (FIGS. 3 and 4), open the blanks to a tubular configuration, seal the bottom closures BC of the blanks B to form cartons C, sterilize the cartons, fill the cartons, seal the top closures TC of the cartons, and thereafter stamp suitable identifying indicia on the cartons before discharging the filled and sealed cartons from the machine. Because of the many operations performed on the cartons as they pass through the machine, the different sections of the machine in which successive operations on the cartons are performed will be identified as consecutively numbered processing stations S1 through S22.

The carton forming and filling machine 50 (FIGS. 1 and 2) broadly includes a forming or dry section 52, and a filling or wet section 54 interconnected to the dry section by a carton sterilizing and accumulating section 56. The cartons are advanced through the forming section 52 (stations S1—S11) in two rows by an intermittently driven carton forming turret 58 having an upper and a lower series of horizontally disposed, equally spaced, mandrels 60 and 61, respectively. The two rows of cartons are then transferred into the sterilizing and accumulating section 56 (stations S12 and S13) where a pair of continuously driven accumulating conveyors 62 and 64 of an accumulator 65 advance the two rows of cartons into accumulating guideways 66 of the accumulating section 56. The two rows of cartons form two columns of cartons in the guideways, permitting the lower carton in each column to be transferred upon demand of the filling section 54 onto a common continuously-driven carton transport conveyor 68 of the filling section 54 (stations S14 to S22) during which time the cartons are filled, sealed, marked, and subsequently discharged from the machine 50.

In general, the cartons progress through the following operating components at the twenty two processing stations in the following manner. An upper magazine 70 at station S1 (FIGS. 1 and 2) and a lower magazine 71 at station S2, each receives a stack of flat folded carton blanks B (FIGS. 3 and 4). The folded carton blanks B are withdrawn from the upper magazine 70 (FIGS. 1 and 2) by an upper erecting mechanism 72 at the station S3 which overbends the blanks and places them one at a time in the form of an open end tube of square cross-section in position to be engaged by an upper loader 74 which is also located at station S3 and pushes the squared carton blanks onto the associated upper mandrels 60 with the bottom closures projecting outwardly therefrom. Similarly, carton blanks are withdrawn from the lower magazine 71 by a lowered carton erecting mechanism 76 at the station S4 which places the carton blanks B in position to be engaged by a lower loader 78 which pushes the carton blanks one at a time onto the lower mandrels 61 as the lower mandrels are intermittently registered with the loader 78 at station S4. Thus when erected cartons are disposed on the mandrels 60 and 61 the top end of each carton is disposed inwardly

toward the axis of the turret while the bottom of the carton is positioned near the periphery of the turret.

After a pair of open-ended, tubular carton blanks B have been placed on an upper mandrel 60 and on a lower mandrel 61, which mandrels lie in common vertical planes, the intermittently driven forming turret 58 indexes the cartons to station S5 where identical bottom forming heads 80 of a bottom former 81 engage the bottom closure flaps of the carton blanks and bend the flaps about score lines formed in the bottom closure. The cartons are then advanced to station S6 where heating heads 82 of a bottom heater 84 direct hot air at only those portions of the bottom closure flaps which are subsequently sealed together. After being partially heated at station S6, the cartons are advanced to station S7 where other bottom heating heads 82 of the bottom heater 84 direct additional hot air at only those flaps of the bottom closures which are subsequently sealed together to complete the bottom heating operation, leaving the thermo-plastic material on the bottom flaps thereon in a tacky condition suitable for sealing. The cartons with the heated bottom closures are then moved past roller plows 86 at station S8 which folds the bottom closure flaps together so that they are in sealing position as they reach the preliminary bottom sealing heads 88 of a preliminary bottom sealer 89 at the preliminary bottom sealing station S9. After the bottom closures are partially sealed at station S9 they are advanced to station S10 where final sealing heads 90 of a final bottom sealer 91 completely seal the bottom closures and crush certain portions of the bottom closure flaps to block any potential undesirable flow passages in the bottom closures. The cartons with their bottom closures sealed are then advanced to station S11 wherein an unloading mechanism 92 removes the partially closed cartons from the mandrels 60 and 61 and moves the cartons into positions to be received by the accumulator conveyors 62 and 64 of the sterilizing and accumulating section 56.

The two rows of cartons are then continuously moved upwardly by the conveyors 62 and 64 past ultraviolet lights 94 at station S12 thereby sterilizing the cartons. Continued movement of the accumulator conveyors 62 and 64 carries the cartons to station S13 wherein the cartons are deflected from the conveyors 62 and 64 and gravitate into the carton accumulating guideways 66 where two stacks or columns of cartons with their bottom closures sealed are accumulated for subsequent feeding into the filling section 54 upon demand from the filling section.

At station S14, two cartons, one from each guideway 66, are transferred onto the continuously driven carton conveyor 68 by a carton feed mechanism 96. The feed mechanism 96 cooperates with certain parts of a crimping turret 98 (FIG. 2) at station S15 to crimp certain tabs of the top closures of the cartons and positively seat the cartons on the conveyor 68. The cartons are then advanced to station S16 where a top forming turret 100 bends certain flaps of the top closures around score lines formed in the top closures. The cartons then move past a no-carton no-fill turret 102 at station S17 and into a filling turret 104 at station S18 where all cartons are filled by one of eight identical filling heads 105 with the liquid being processed. After being filled, the cartons are advanced to a top heating turret 106 at station S19 where those flaps of each top closure, which are subsequently sealed together, are heated to the bonding temperature by hot air. The cartons are then advanced to a top sealing turret 108 at station S20 where the heated top closures are sealed. The filled and sealed cartons are then advanced past the marking station S21 where a marking turret 110 impresses suitable carton identifying indicia upon the cartons. The cartons are then discharged from the carton former and filler 50 by a continuously driven discharge conveyor 112 at station S22.

THE CARTONS

Although the cartons per se form no part of the present invention, the construction of the quart carton C (FIGS. 3 to 11) will be described in detail in order to facilitate understanding the carton closing and filling machine 50 of the present invention. Since the one-third quart carton C1 (FIG. 7), the pint carton C2 and the half pint carton C3 have top closures TC and bottom closures BC which are identical to the top and bottom closures of the quart carton C, only the quart carton C will be described in detail.

The material from which the carton C is formed is cardboard having a polyethylene coating on both surfaces to provide a finished carton of five barrier construction with the polyethylene coating on its outside and inside surfaces. Each carton blank B (FIGS. 3 and 4) is supplied in flat folded form by the carton manufacturer. The carton blank B includes a top closure TC and a bottom closure BC which are formed from opposite ends of four walls, i.e., a front wall 121, a rear wall 123, and side walls 122, and 124 (FIG. 5). The walls 122 and 123 are connected together by a flange 125 (FIG. 4) which is formed on wall 123 and connected thereto along fold line 125a, and is sealed to the wall 122 in overlapping relation. The front or pouring wall 121 is provided with a central longitudinally extending score line 126 and an inverted V-shaped score line 127 to facilitate slight outward bending of the carton wall 121 principally along the central score line 126 when milk is to be poured therefrom by the customer. Transverse score lines 128 and 129 are formed across the lower end and upper end, respectively, of each wall 121, 122, 123 and 124 to facilitate the bending of the bottom closure BC and the top closure TC relative to the side walls during closure of the ends of the carton.

The bottom closure BC includes a front flap 132 (FIG. 5) projecting from and forming part of the wall 121, and a flap 133 projecting from wall 123, each flap being provided with a V-shaped score line 134 to facilitate the inward bending of the flaps and to define triangular sections 132a, 132b, 133a and 133b (FIG. 5). The bottom closure also includes a flap 136 that is an extension of wall 122 and which is slightly longer than the opposed bottom flap 138 so as to provide a lip 137 (FIG. 6) which is adapted to overlap and be subsequently sealed to the bottom flap 138.

The top closure TC (FIGS. 8 to 11) includes a front flap 139 projecting from wall 121, a flap 141 projecting from rear wall 123, a flap 142 projecting from wall 124 and an opposing side flap 143 projecting from wall 122. Each upper flap includes an upper transverse score line 144 which is disposed above and is parallel to an adjacent score line 129. The cardboard base, but not the polyethylene coating, at the score line 144 on the front flap 139 and along portions of the score line 144 on the flaps 142 and 143 adjacent the flap 139 are partially perforated to weaken this area so that the top closure TC can easily be opened by the customer by tearing along this perforated line. As shown in FIGURE 8, tabs 146 and 147 on the front and rear flaps 139 and 141, respectively, are bent outwardly, while oblique score lines 148 on the front and rear flaps permit the upper flaps to be bent inwardly. Shallow ears 149 project from the front and rear flaps on the side adjacent the flap 142, long ears 151 on the other side of the front and rear flaps, a narrow lip 152 on flap 143, and a wide lip 153 on the flap 142 cooperate when the top of the carton is closed as indicated in FIGURE 11 to provide a rigid interlaced joint for the top closure TC.

THE CARTON FORMING TURRET

The carton forming turret 58 (FIGS. 12-21) of the carton forming section 52 is provided for the purpose of supporting the carton blanks B while the necessary oper-

ations are performed on the bottom closures BC to seal the bottom closures of the cartons. As mentioned previously, the turret 58 includes an upper series of radially projecting mandrels 60 and a lower series of radially projecting mandrels 61, said mandrels being identical and each lower mandrel 61 lying in a common vertical plane with an associated one of the upper mandrels 60. The turret 58 is intermittently driven so that each pair of vertically aligned mandrels 60 and 61 is indexed step-by-step from station S3 to station S11 during which time the bottom closures of the cartons are preformed, heated and sealed, and are then pulled free from the mandrels at station S11 after their bottom closures have been sealed.

The turret 58 (FIGS. 12-15) is supported by a rigid cast frame 160 which is mounted on adjustable legs 161 that may be adjusted so as to compensate for minor variations in the elevation of the floor of the dairy thereby assuring that the axis of rotation of the turret will be maintained vertical. Tie rods 159 (FIG. 13) are provided for rigidly connecting the frame 160 of the forming section 52 to the filling section 54. The frame 160 has an intermittent driving unit 162 (FIG. 15) such as a Ferguson drive, bolted thereto. The Ferguson drive may be Model QPF125 Roller Gear Drive, Code 8, 5304M-90 marketed by Ferguson Machine Corporation, 7818 Maplewood Industrial Ct., St. Louis, 17, Mo. The intermittent driving unit 162 intermittently advances the upper row and the lower row of cartons through the forming section 52 at approximately sixty cartons per minute. In operation the turret is in motion 20% of the time and is stationary while the cartons are at the various stations for 80% of the time. The drive unit 162 includes a vertically extending tubular shaft 163 journaled for rotation in a drive housing 165 which is bolted to the frame 160. The shaft 163 has a turret-supporting flange 164 welded to the upper end thereof. The base 166 of a cylindrical turret hub 167 is bolted to the flange 164 and has a central aperture 168 therein which communicates with a passage 169 in the tubular shaft 163.

As clearly indicated in FIGURES 14 and 15, eight upper mandrels 60 and eight lower mandrels 61 are bolted to the periphery of the turret hub 167 and project radially outwardly therefrom at evenly spaced intervals to define an upper and a lower horizontal series of mandrels.

It will be appreciated that each mandrel is a substantially solid metal member and is subjected to considerable heat at the heating stations S6 and S7 and, accordingly, must be cooled to prevent the cartons from adhering to the mandrels after prolonged operation. Therefore, each upper mandrel 60 has a U-shaped liquid coolant passage 171 therein which communicates with an associated radial inlet passage 172 formed in the tubular hub 167, and with a radial outlet passage 173 formed in the hub 167 above the inlet passage. Similarly, each lower mandrel 61 has a liquid coolant passage 174 (FIG. 15) therein which communicates with an associated radial inlet passage 175 and with an associated radial outlet passage 176 formed in the tubular hub 167.

In order to direct coolant water through the mandrels, a supply conduit 177 (FIG. 15) is connected to a source of water under pressure and to a swivel joint 177a which is of the type that permits rotation of the turret while maintaining a fluid-tight connection. The joint 177a communicates with an axial supply passageway 178 formed in a water distribution manifold 179 that is inserted within the tubular hub 167. The manifold 179 includes a cover 180 which is bolted to the upper end of the tubular hub 167 and is sealed thereto in fluid tight relationship by an O-ring 181. An annular groove 182 formed in the outer periphery of an upper, large diameter distribution disc 183 of the manifold 179 communicates with all the upper inlet passages 172 in the tubular hub 167 and with the axial supply passageway 178 through four radial passages 184 in the disc 183. O-rings 186 are provided on both sides of the annular groove 182 to

seal the disc 183 to the internal surface of the hub 167. A lower, large diameter distribution disc 188 is provided with an annular groove 189 which is connected with the axial supply passageway 178 by radial passages 191 and supplies high pressure coolant water to each of the lower inlet passages 175 for distribution through the lower mandrel 61. O-rings 192 are provided on opposite sides of the groove 189 in the periphery of the disc 188 to seal the disc 188 to the internal surface of the hub 167. A plug 194 blocks the lower end of the supply passageway 178 and accordingly, all inlet water must be directed through the mandrels 60 and 61 prior to being returned to the hub 167 through the upper outlet passages 173 and lower outlet passages 176. This heated coolant water then flows through vertical passageways 196 formed in the upper disc 183 and in the lower disc 188 and in the hub portion connecting the discs. From the passages 196 the heated water passes into and through the aperture 168 in the base 166 of the hub 167 before being discharged from the machine through the passage 169 in the tubular shaft 163 of the intermittent driving unit 162.

The upper mandrels 60 and lower mandrels 61 are identical, accordingly, only one of the upper mandrels 60 (FIGS. 16-21) will be described in detail. As mentioned previously, each mandrel 60 serves the purpose of supporting the associated carton C while the several bottom closing operations are being performed on the bottom closure BC of the carton to seal the same. The mandrel also features an adjustable carton stop 200 thereby adapting the mandrel to handle the previously mentioned four carton sizes.

Each mandrel 60 comprises an elongated carton receiving body 201 having a flange 202 on one end which is bolted to the turret hub 167. An elongated horizontal slot 203 (FIG. 17 and 19) and an elongated vertical slot 204 (FIGS. 16 and 19) extend longitudinally of the mandrel 60 and cut transversely through the center of the mandrel. The slots 203 and 204 terminate near the opposite ends of the mandrel and cooperate with an upper generally V-shaped groove 206 (FIG. 19) and a lower somewhat V-shaped groove 207 to accommodate the carton stop 200. A latch plate 208 (FIG. 21) with a longitudinally extending slot 209 therein, which registers with the vertical slot 204, is bolted in the lower V-shaped groove 207 and is provided with transversely extending locking grooves 210, 211, 212 and 213 that selectively receive locking ears 214 of a latch plate 215 to thereby lock the adjustable stop 200 in either the quart, one-third quart, pint, or the one-half pint positions.

The adjustable carton stop 200 comprises a vertically extending slide block 216 (FIGS. 19 and 20) which is slidably received in the vertical slot 204 and includes a pair of spaced downwardly projecting ears 217 which project outwardly of the lower V-shaped groove 207 in position to be engaged by a leading edge of the top closure of the carton blank B as the blank is moved onto the mandrel. An upper angle member 219 is bolted to the slide block 216 and includes a pair of upwardly projecting spaced ears 221 which engage another edge of the top closure of the carton blank to hold the carton blank in desired position on the mandrel. A horizontally disposed tab breaking plate 223 is slidably received in the horizontal slot 203 and is slotted at 224 (FIG. 19) to receive a portion of the vertically extending slide block 216. The vertical block 216 is provided with a similar slot 226 (FIG. 20) to receive a portion of the tab breaking plate 223 which plate is rigidly secured to the body 216 by a capscrew 227. The breaking plate 223 has ears 228 and 229 (FIG. 16) which project outwardly of the body 201 and includes curved tab breaking surfaces which bend the tabs 146 and 147 outwardly. The carton blank B is held in desired position on the mandrel by a spring clip 232 which is bolted at one end to the tab breaking plate 223 while the other end resiliently engages the carton blank to hold the same on the mandrel.

In order to shift the adjustable carton stop 200 from the quart carton position to any of the other carton size positions, a double shouldered bolt 236 (FIG. 20) is slidably received in a mating bore 238 formed in the vertical slide block 216. The latching plate 215 is rigidly secured between a shoulder 239 on the bolt 236 and a nut 241 screwed on the lower end thereof. A compression spring 242 is disposed between a shoulder 243 on the bolt 236 and a shoulder 244 in the bore 238, and normally urges the locking ears 214 upwardly into the pre-selected groove 210, 211, 212 or 213, depending upon what size carton is being handled. When it is desired to change carton sizes, the bolt 236 is merely pushed downwardly against the urging of the spring 242 and the adjustable carton stop 200 is moved to the desired position longitudinally of the mandrel. The bolt 236 is then released so as to urge the ears 214 in the proper locking grooves 210, 211, 212 or 213.

As shown in FIGURES 16 and 17, each mandrel is provided with a flap engaging head 246 which is secured to the free end of the mandrel by studs 247 and cooperating nuts 248. The head 246 has a flat pressure resisting face 249 with an open centered, triangle-shaped raised portion 251 thereon. When the flaps of the bottom closure are folded during the sealing operation, the triangle-shaped portion fits within the carton to compensate for varied bottom wall thickness caused by different numbers of layers of bottom closure walls being used to define the sealed bottom closure of the carton. The periphery of the head 246 is chamfered so as to more readily receive the carton blank B and grooves 252 and 253 (FIG. 18) are formed in the upper and lower edges of the head 246 to provide for the subsequent mechanical discharge of the cartons from the mandrels. A recess 254 (FIG. 18) is provided in one corner of the head 246 to accommodate the extra carton thickness at this point resulting from a portion of the carton wall flange 125 (FIG. 3) being disposed in this area during the bottom sealing operation.

It will be understood that the carton engaging stop ears 217 and 221 of the adjustable carton stop 200 are locked by the locking ears 214 in positions which will cause the transverse score lines 128 on the bottom of the carton to lie in the plane of the pressure resisting face 249 at the outer end of the head regardless of what size carton is positioned on the mandrel.

The drive train 260 for the turret 58 and other components of the forming section 52 is best illustrated in FIGURES 12 and 13. The drive train 260 receives power from a variable speed motor 3M which includes a magnetic brake to immediately stop the motor when de-energised. The motor 3M is connected by a belt drive 266 to an overload clutch 264, such as a Maxitorq clutch Model No. 24 marketed by Carlyle Johnson Co., 52 Main St., Manchester, Conn. The clutch 264 drives a gear reducer 268 having cams 270 and 272 secured to output shafts thereof. Another output shaft 273 of the gear reducer 268 is connected by a flexible coupling 274 to the input shaft 276 of the intermittent driving unit 162 thereby intermittently driving the forming turret 58.

A continuously driven output shaft 277 of the driving unit 162 is connected by a flexible coupling 278 to a lower right angle gear box 279 which is, in turn, coupled to an upper right angle gear box 281 which includes an output shaft 282 which has its axis angled at approximately 45° relative to the axis of an output shaft 283 of the lower right angle gear box 279. The upper right angle gear box 281 includes a second, vertically extending output shaft 284. A second continuously driven output shaft 286 (FIG. 13) of the driving unit 161 has a sprocket 287 and a barrel cam 288 secured thereto which sprocket and cam drive other components of the forming section 52 and sterilizing and accumulating section 56 of the carton former and filler 50. The sprocket 287 is connected by a chain drive 289 to a sprocket 289a on the input shaft 290 of a right angle gear box 291.

As illustrated in FIGURES 1 and 2, two carton magazines are provided. The upper magazine 70 is disposed at station S1 to supply carton blanks B to the upper series of mandrels 60, and the lower magazine 71 is disposed at station S2 to supply carton blanks to the lower series of mandrels 61. Since the carton forming and filling machine 50 is adapted to handle four different carton sizes, the magazines 70 and 71 feature adjustable means which adapt them to selectively handle each of the four sizes of carton blanks B illustrated in phantom lines in FIGURE 23. The magazines 70 and 71 are inclined downwardly at approximately 30° so that the carton blanks B will gravitate from the upper inlet end 292 of each magazine to the lower discharge end 293 thereof. The upper magazine 70 and lower magazine 71 are identical, accordingly, only the upper magazine 70 will be described in detail.

The magazine 70 comprises a cast sub-frame 294 (FIGS. 22 and 23) having a pair of upstanding arms 296 and 297 formed integrally therewith, the arms 296 and 297 being on the same side of the magazine, with the arm 296 being disposed adjacent the inlet end 292 of the magazine and the arm 297 being disposed adjacent the discharge end 293. An elongated, fixed guiding and supporting rail 298 is rigidly bolted to the arms 296 and 297 and extends the full length of the magazine in order to engage and guide the bottom closures of the folded carton blanks B from the inlet end of the magazine to the discharge end thereof. The fixed rail 298 includes a carton supporting flange 299 (FIG. 23) upon which one edge of the bottom closure is supported, a lower vertical guiding surface 301 and an upper vertical guiding surface 302 which serves to guide the left end (FIG. 23) of the bottom closure of the carton blanks B, and an elongated flange 303 which fits over a horizontal edge 304 of a lower carton flap to prevent upward movement of the carton blanks as they gravitate down the inclined magazine 70.

A pair of adjustment shafts 306 and 307 are secured to the frame 294 below the guide rail 298 and extend transversely thereof. Upstanding movable arms 308 (FIG. 24) and 309 (FIG. 23) are slidably supported on the shafts 306 and 307, respectively, and have an elongated moveable guiding and supporting rail 311 secured thereto. The rail 311 includes a carton supporting flange 312, a lower vertical guiding surface 313, an upper vertical guiding surface 314, and an angle flange 316 which fits within a slot 317 in the top closure flaps of the carton blanks B when the blanks are in the flat folded condition.

It will be appreciated that the flat carton blanks are positioned transversely to the magazine, and in FIGURE 23, cartons of four different sizes are shown in phantom lines, the largest carton extending from the fixed rail 298 to the movable rail 311. In order to accommodate all four sizes of carton blanks, the rail 311 is selectively movable on the shafts 306 and 307, each of which is provided with annular grooves 318, 319, 320, 321, 322 and 323, certain ones of which accommodate resilient hairpin locks 324 (FIGS. 23-25) for locking the movable rail 311 in selected position. Each hairpin lock 324 is received in a slot 326 (FIG. 25) formed in the hubs 308a and 309a of the arms 308 and 309 and is resiliently urged into the appropriate annular groove. The grooves 321 are provided for one-half pints, grooves 322 for one-third quarts, grooves 323 for pints, and grooves 324 for the quart size carton blanks. In order to change carton sizes, the pins 324 are first withdrawn from their slots, the arms 308 and 309 with the rail 311 attached thereto, are then shifted to the new carton size position, and the pins 324 are then inserted into the proper annular grooves thereby locking the movable rail 311 in desired carton guiding position.

In order to assure positive movement of the carton blanks B downwardly to the discharge end 293 of the

magazine 70, a weighted pusher 327 (FIGS. 22 and 23) is provided. The pusher 327 includes an apertured carrier 328 which is slidably received on an elongated shaft 329 which extends longitudinally of the magazine 70. Carrier stabilizing rollers 331 are journaled on bolts 332 secured to the carrier and projecting downwardly into position to slidably engage a shaft 333 which is parallel to and is disposed below the shaft 329. The shafts 329 and 333 are bolted at their lower ends to a slide block 334 and have their upper ends received within parallel holes in a second slide block 338. The slide blocks 334 and 338 are slidably supported for transverse movement on the adjustment shafts 306 and 307.

Resilient hairpin locks 339 are provided to lock the pusher 327 in selected position for the four sizes of carton blanks and are selectively inserted in slots 341 formed in the slide blocks 334 and 338. The hairpin locks 339 are selectively positioned to resiliently engage the aforementioned annular grooves 318, 319 or 320 in the adjustment shafts 306 and 307. When the locks 339 are fitted in the slots 320, the pusher 327 is in proper position to handle quart size carton blanks. When the blocks 334 and 338 are locked in the position shown in FIGURE 25 by engagement of the locks 339 with the grooves 318 the pusher 327 is locked in position to handle one-third quart and one-half pint size carton blanks. Engagement with the slot 319 locks the pusher in position to handle pint size blanks.

The pusher 327 includes a pivotal pusher plate 343 having an upper end 344 which engages the rearmost carton blank in the magazine 70 near its vertical midpoint. The plate 343 is journaled on a shaft 345, and the shaft 345 is journaled in the ears 346 projecting upwardly from the carrier 328. A torsion spring 347 is wound around the shaft 345 and has one end secured to the carrier 328 while the other end engages the pusher plate 343 and urges it in a clockwise direction, as viewed in FIGURE 22, to normally hold the free end of a stop finger 348 in abutting engagement with the carrier 328. The stop finger 348 is integral with the plate 343 and accordingly the plate 343 is held in the position shown in FIGURE 22 during normal operation of the machine.

When the supply of carton blanks B in the magazine 70 becomes low and it is desired to add additional blanks to the magazine, a new case of approximately 250 sterilized carton blanks is inserted into the upper inlet end 292 of the magazine 70. The operator grips a handle 349 projecting outwardly from the carrier 328 and pulls the carrier toward the upper inlet opening 292 while holding the new supply of cartons from movement. The pusher plate 343 at this time pivots downwardly against the urging of the spring 347 until the plate is moved below and past the new supply of carton blanks. When the plate is on the upper side of the blanks, the spring returns the plate to its normal carton pushing position behind all the carton blanks in the magazine. Release of the handle 349 by the operator then causes the plate to gravitate against the rearmost carton blank thereby urging all of the blanks toward the lower discharge end 293 of the magazine 70.

The foremost carton blank in the magazine is held from gravitation discharge therefrom by upper carton arresting fingers 351 (FIG. 23) and lower carton arresting fingers 352 and 353. The upper fingers 351 project downwardly from a support bar 354 that is bolted to an inverted U-shaped bracket 356 which is, in turn, bolted to upstanding legs 357 (FIG. 24) and 358 (FIG. 22) of the sub-frame 294 at the lower discharge end 293 of the magazine 70. The lower arresting finger 353 is bolted to the fixed arm 297, and the other lower finger 352 is bolted to the movable arm 308 and accordingly is adjusted with the adjustable rail 311. It will be understood that the fingers 351, 352 and 353 cooperate to retain the carton blanks B in the magazines 70 or 71 until the associated carton erecting mechanisms 72 or 76 remove the

carton blanks B therefrom. If the supply of cartons in the magazine is diminished to such an extent that the supply of cartons is moved off a normally open limit switch 315 thereby permitting the switch to open, certain electrical controls to be described hereinafter will be actuated to prevent further removal of cartons from the magazine 70 during normal automatic operation of the machine 50.

ERECTING AND LOADING MECHANISMS

The upper carton erecting mechanism 72 (FIG. 26) is located at station S3 (FIG. 2) and receives flat folded carton blanks B from the upper magazine 70, squares and overbends the carton blanks, and then places the squared blanks B one at a time in position to be engaged by the upper mandrel loader 74 and be pushed onto one of the upper mandrels 60 of the carton forming turret 58. At station S4, the lower carton erecting mechanism 76 (FIGS. 43 and 44) similarly receive carton blanks B from the lower magazine 71, squares and overbends the carton blanks, and then place the squared blanks in position to be engaged by the lower mandrel loader 78 which pushes the squared blanks onto the lower mandrels 61 of the turret 58.

Because the upper erecting mechanism 72 and upper loader 74 are quite similar to the lower erecting mechanism 76 and lower loader 78, only the upper erecting mechanism and loader, and the parts common to both upper and lower components, will be described in detail. Parts of the lower erecting mechanism 76 and lower loader 78 which are equivalent to parts of the upper erecting mechanism 72 and loader 74 will be assigned the same numerals followed by the letter a.

The upper carton erecting mechanism 72 (FIGS. 26-42) comprises a cast sub-frame 366 (FIGS. 26-30 and 42) which is bolted to the main frame 160 of the carton forming section 62 and is oriented with the sub-frame 366a of the lower carton erecting mechanism 76 as indicated in phantom lines in FIGURE 42. The discharge end 293 of the upper magazine 70 is connected to a cross-shaft 367 (FIGS. 26 and 27) that is supported by brackets 368 and 369 that are bolted to upstanding side walls 370 and 371 of the sub-frame 366.

A suction head 372 (FIGS. 26-30) having three suction cups 373, 374 and 376 thereon is bolted to an L-shaped bracket 377 (FIG. 28) that is journaled on a bolt 378. The bolt 378 is secured to one end of a head supporting bell crank 379 that is journaled on a bolt 380 secured to the upstanding wall 371 of the sub-frame 366. An actuating arm 381 of the bell crank 379 is pivotally connected to one end of the connecting rod 382 that has its other end journaled on a stud 383. The stud is eccentrically mounted on a crank disc 384 that is concentric with and is bolted to the flat face of a cam 385 that is keyed to the output shaft 282 of the aforementioned gear box 281 (FIGS. 13 and 27). The crank disc 384 may be mounted for a limited amount of angular adjustment relative to the cam 385 by any suitable means such as that illustrated in FIGURE 26. Thus, rotation of the output shaft 282 will cause the bell crank 379 to swing through a predetermined arc about the axis of the bolt 380.

In order to cause the suction head 372 to pivot about the axis of the bolt 378, a suction head shifting bell crank 387 has a cam follower 388 journaled on one end thereof which cam follower rides in a cam way 389 defined by two plates 391 and 392 bolted to the L-shaped suction head supporting bracket 377. The bell crank 387 is journaled on a bolt 393 that is secured to the upstanding frame wall 371. The other end of the bell crank 387 is pivotally connected by an adjustable link 394 to a stud 396 which projects outwardly from the head supporting bell crank 379 as clearly indicated in FIGURES 29 and 30. Thus, one complete rotation of the output shaft 282 and of the disc 384 will cause the suction head 372 to move from the carton pickup position shown in FIG-

FIGURE 29 to the carton discharge position shown in FIGURE 30 and thereafter will return to the pickup position.

The suction head 372 (FIGS. 28, 31, 32 and 33) comprises a body 401 having an elongated passage 402 formed therein which passage communicates with a flexible suction supply conduit 403 and with ports 404 and 406 (FIG. 32) formed in the bolts 407 which secure the suction cups 374 and 376 to the body 401. A second elongated passage 408 (FIG. 31) communicates with the supply conduit 403 through a valve housing 409, which is part of the body 401 and with the suction cup 373 through passages 411 and 412 (FIG. 31).

When quart size carton blanks B are being handled, the blanks are gripped by the three suction cups 373, 374 and 376. However, when pint, one-third quart and one-half pint size blanks are being handled, the suction cup 373 does not engage the blank and accordingly the vacuum supply to the cup 373 must be interrupted. Such interruption is rapidly and effectively accomplished by a shutoff valve 414 that is partially inserted within the valve housing 409.

The valve 414 comprises a conical valve head 416 which is secured to a valve stem 417 slidably received in a cap 419 which is screwed into the open end of the valve housing 409. A helical compression spring 421 disposed between the valve head 416 and the cap 419 normally urges the head toward port closing position against a valve seat 422 formed in the valve housing 409 which, when closed, prevents suction from being created within the housing. An operator's control pin 423 extends transversely through the end of the valve stem 417 and may be gripped by an operator when it is desired to shift the valve between an open and a closed position. The valve head 416 is maintained in the open position by a lock pin 424 which is secured to the stem 417 and bears against the outer face of the cap 419. When it is desired to close the valve 414, the stem is pivoted 90° allowing the lock pin 424 to seat in a slot 426 formed in the cap 419.

A rotary vacuum control mechanism 429 (FIGS. 34-39) is provided in order to control the application of vacuum to the suction distribution conduit 403 and to the suction cups when the cups are moving between the carton blank pickup position shown in FIGURE 29 and the carton blank discharge position shown in FIGURE 30, and to thereafter vent the suction cups when the cups are returning to the pickup position.

The vacuum control mechanism 429 is driven in timed relation with the movement of the suction head 372 from the vertical output shaft 284 (FIGS. 13, 34 and 35) of the aforementioned upper right angle gear box 281. The shaft has a crank arm hub 432 keyed thereon which has a vacuum control drive gear 433 (FIG. 35) bolted to the lower surface thereof. The drive gear 433 meshes with an idler gear 434 which is journaled on a bolt 436 that is secured to a bracket 437 bolted to the gear box 281. The idler gear 434 meshes with a vacuum distribution gear 438 that is journaled on a shouldered bolt 439 which is secured to the bracket 437. The gear 438 is sandwiched between an upper nylon disc 440 and a lower nylon disc 441 and is held firmly thereagainst by a compression spring 442 which is disposed between the head of the bolt 439 and a pressure plate 443. The upper disc 440 communicates with a source of vacuum by means of a vacuum supply conduit 444 which is fitted through an opening in the pressure plate 443 and is screwed into a port 445 in the upper disc 440. The upper disc 440 is held from rotation by an angle stop bar 446 which is bolted to the bracket 437 and is notched at 447 to receive the vacuum supply conduit 444. Similarly, the lower disc 441 establishes communication with the source of vacuum and is held from rotation by a supply conduit 448 which fits through a hole in the bracket 437 and is screwed into a port 449 in the lower disc 441.

As illustrated in FIGURES 36-39, an arcuate groove 454 is formed in the upper surface of the distribution

gear 438 and registers with the upper vacuum supply conduit 444 during the time the upper suction head 372 moves between the carton pickup position and the discharge position illustrated in FIGURES 29 and 30, respectively. During this time, suction is communicated to the upper suction head 372 from the source of supply, through the conduit 444, through the upper arcuate groove 454, through a radial groove 456 (FIG. 38) formed in the lower surface of the upper nylon disc 440 and into the upper suction head 372 through the conduit 403.

After the carton blank has been removed from the upper magazine 70 and is being placed in the discharge position, the gear 438 which is rotating in a counterclockwise direction is moved to the position shown in FIGURE 36 wherein the arcuate groove 454 has moved out of registry with the radial groove 456. At this time, the suction cups 373, 374 and 376 are vented to the atmosphere through the conduit 403, through a short arcuate groove 457 (FIGS. 36 and 37) in the gear 438 and to the atmosphere through a radial passage 458 in the gear. Continued counterclockwise rotation of the gear 438 will terminate the venting and the vacuumizing of the cups until the conduit 444 again establishes communication with the arcuate groove 454 which occurs as the suction head 372 moves into the pickup position illustrated in FIGURE 29.

Similar grooves in the lower surface of the distribution gear 438 and in the upper surface of the lower nylon disc 441 control the venting and supply of suction to the lower suction head 372a (FIGS. 43 and 44).

Since the material from which the carton blanks B are formed is rather stiff and tends to remain in the flat folded position, it is desirable to overbend the carton blanks, i.e., to bend the carton blanks past a squared position as indicated in FIGURE 40 so as to reduce the resilience of the carton material which tends to return the carton blank to the flat folded position. Accordingly, an overbend plate 462 (FIGS. 22, 26 and 40) is provided and has flanges 463 (only one being shown) projecting downward therefrom and connected to brackets 464 by bolts 465. The brackets 464 are rigidly secured to the frame 294 of the magazine 70 by cap screws 466 and cooperating tubular spacers 467 (FIG. 24). The position of the overbending plate 462 may be varied by pivoting the plate 462 about one of the bolts 465 while the other bolt swings within an arcuate slot 468 in the associated flange 463. The plate 462 includes an edge engaging section 469 which is maintained in a substantially horizontal plane, and an upwardly inclined side engaging section 471 which is provided with a curved outer edge 472.

In order to aid the suction head 372 and sharply overbend the carton as indicated at 374 in FIGURE 40, a nylon overbend bar 476 is bolted to a bracket 477 which is in turn bolted to the suction head 372. As clearly indicated in FIGURE 40 the overbending bar 476, when positioned at 374, moves quite close to the curved edge 472 thereby sharply overbending the carton blank prior to its introduction in the form of a square, open-ended tube in position to be engaged by the upper loader 74 (FIG. 41).

The upper loader 74 (FIGS. 26, 27, 29, 41 and 42) includes a pivotal gate 481 which pivots from an inclined position to a vertical position to first receive the carton blank B and thereafter hold the blank in squared position as it is being moved onto the associated upper mandrel 60. A reciprocable pusher 482 (FIGS. 27 and 29) having a Y-shaped pusher finger 483 bolted thereon is provided for pushing the squared carton blank onto the particular upper mandrel 60 that is indexed at station S3.

As shown in FIGURE 40, the squared carton blank B is received upon a support table 484 which defines a pair of support rails 486 and 487 (FIGS. 27, 29, 40 and 41) having a slot 488 therebetween. A vertically extending fixed carton squaring plate 489 is bolted to the rail 486 and projects upwardly therefrom to engage one wall of the squared carton blank. The table 484 is of one-

piece cast construction and is bolted to an angle bracket 491 which is, in turn, bolted to the sub-frame 370.

The pivotal gate 481 is welded to a tubular shaft 492 which is journaled on a fixed shaft 493 that is secured to the table 484 adjacent the rail 487. A lever arm 494 is secured to and projects outwardly from the tubular shaft 492 and has its free end pivotally connected to one end of an adjustable link 496. The other end of the adjustable link 496 is pivotally connected to one end of a bell crank 497 which is journaled on a bolt 498 that is secured to a bracket 499 (FIG. 28) bolted to the frame 160 of the forming section 52. A cam follower 501 is journaled on the other end of the bell crank 497 and rides in a cam groove 502 in the aforementioned face cam 385 thereby actuating the gate 481 in timed relation with the movement of the suction head 372.

With the carton blank held in the squared position by the rails 486 and 487, the fixed squaring plate 489 and the pivotal gate 481, the reciprocable pusher 482 engages the carton blank and pushes it through a guide chute 504 (FIGS. 27, 29 and 41) which is formed integrally with the table 484 and projects through an opening in the upstanding wall 370 of the sub-frame 366. The chute 504 includes a lower wall 505 that is aligned with the rails 486 and 487, an upstanding wall 506 aligned with the fixed plate 489, a second upstanding side wall 507 aligned with the pivotal gate 481 when the gate is in the vertical position, and a top wall 509. The walls 507 and 509 have outwardly flared inlet flanges 508 and 511, respectively, to aid in guiding the carton into the chute 504. As indicated in FIGURE 41, the discharge ends of the walls 505, 506 and 509 terminate at a point immediately adjacent the associated upper mandrel 60 so as to accurately guide the carton blank onto the mandrel. The second upstanding wall 507 terminates at 512 which is spaced outwardly from the end of the mandrel 60 a distance sufficient to permit the bottom closure of the carton blank which projects outwardly from the mandrel, to swing freely out of the chute 504 as the turret is indexed between station S3 and station S4.

The reciprocable pusher 482 comprises a main body 516 which is slidably mounted on shafts 517 and 518 which extend transversely of the frame 370 and are rigidly secured thereto. The Y-shaped finger 483 (FIG. 29) is bolted to the body 516 and projects upwardly through the slot 488 in the table 484. Flat faced pusher bolts 519 are screwed into the upper end portions of the Y-shaped finger 483 and are locked into desired position by nuts. The bolts 519 engage the uppermost edge of the bottom closure of the carton blank B at station S3 and, upon reciprocation of the pusher 482, pushes the squared blank onto the associated mandrel 60.

As best shown in FIGURE 42, the pusher 482 is reciprocated in timed relation with the other components of the upper erecting mechanism 72 and loader 74 from a crank disc 522 which is locked in adjusted position onto the aforementioned crank arm hub 432 (FIGS. 35 and 42) by capscrews 523. The crank disc 522 has a crank pin 524 projecting upwardly therefrom which pin is journaled in one end of a connecting rod 526. The other end of the connecting rod 526 is pivotally connected to an arm 527 of a bell crank 528 which is journaled on a shaft 529 secured to the frame 160 of the dry or forming section 52 of the machine. Another arm 530 of the bell crank 528 is pivotally connected by an adjustable link 531 to the body 516 of the pusher 482. In this way, the pusher 482 is intermittently reciprocated between the carton receiving position shown in phantom lines in FIGURE 42 and the mandrel loading position shown in solid lines in FIGURE 42.

As mentioned previously, the lower carton erecting mechanisms 76 (FIGS. 42, 43 and 44) and lower loader 78 are substantially identical to and operate at the same time as the upper erecting mechanism 72 and upper loader 74. Accordingly, only the drive parts of the lower

mechanisms will be described in detail, and parts of the lower mechanisms which are equivalent to those of the upper mechanisms will be assigned the same numerals followed by the letter *a*.

The lower erecting mechanism 76 and loader 78 are positioned at station S4 (FIGS. 2 and 42). The lower suction head 372a (FIGS. 43 and 44) is operated by a connecting rod 382a which is pivotally connected to a crank pin 534 that is eccentrically secured to a cam 536. The cam 536 is keyed to the previously mentioned output shaft 283 (FIGS. 13, 43 and 44) of the lower right angle gear box 279. The pivotal gate 481a of the lower loader 78 is operated from the bell crank 497a which has a cam follower 501a which rides in a cam groove 537 in the cam 536.

The reciprocable pusher 482a (FIG. 42) of the lower loader 78 is pivotally connected by the adjustable link 531a to a bell crank 538 that is pivoted on a shaft 539 secured to a bracket 541 that is bolted to the sub-frame 366a. An adjustable link 543 pivotally connects the bell crank 538 of the lower loader 78 to the bell crank 528 of the upper loader 74. Thus, all components of the lower erecting mechanism 76 and lower loader 78 operate at the same time and in the same manner as the upper erecting mechanism 72 and upper loader 74.

BOTTOM FORMER

After the carton blanks B have been loaded onto the upper mandrels 60 at station S3 (FIGS. 1 and 2) and onto the lower mandrels 61 at station S4, the carton blanks are advanced to station S5 and are indexed with the associated bottom forming heads 80 (FIGS. 14 and 45-48) of the bottom former 81. Each bottom forming head 80, one being provided for the upper series of mandrels 60 and one being provided for the lower series of mandrels 61, engages and bends the flaps of the bottom closure BC (FIG. 5) about the score lines 128 and 134 to assure that the V-shaped front flap 132 and V-shaped rear flap 133 will bend inwardly, rather than outwardly during the subsequent bottom sealing operation.

The bottom former 81 (FIGS. 45 and 46) comprises a sub-frame 551 that is bolted to the main frame 160 of the form section 52 and includes parallel upstanding end walls 552 and 553 formed integrally with side walls 554 and 556. An upper forming head shaft 557 and a lower forming shaft 558 are aligned with the axes of the upper mandrel 60 and lower mandrel 61 when indexed at station S5. Split blocks 559 and 561 are clamped onto the shafts 557 and 558, respectively and have opposite ends of a vertical stub shaft 562 secured thereto to rigidly interconnect the shafts 557 and 558 for simultaneous reciprocatory movement toward and away from the associated mandrels. A cam roller 563 journaled on the stub shaft 562 is received in the forked end of an arm 564 which arm is secured to the upper end of a vertical shaft 566 journaled in ears projecting outwardly from the wall 556 of the sub-frame 551. An actuating arm 567 is keyed to the lower end of the shaft 566 and has a cam follower 568 journaled on its free end, which cam follower 568 rides in a cam groove 569 formed in the previously mentioned continuously driven cam 270 (FIG. 13).

The bottom forming heads 80 are identical and each head includes a mounting plate 571 which is secured to the associated shaft 557 or 558 as by welding. A pair of flap engaging plows 572 and 573 are rigidly secured to a support plate 574 which is secured to and held in spaced relation from the mounting plate 571 by a plurality of bolts 576 which extend through tubular spacers 577. The plows 572 and 573 have adjacent flap engaging surfaces 578 and 579 which engage the bottom closure flaps 138 and 136, respectively, and cause them to bend inwardly about the score lines 128 when the head is

moved from the position shown in FIGURE 47 to the position shown in FIGURE 48.

In order to assure that the bottom closure walls 132 and 133 are bent inwardly rather than outwardly, wall bending rollers 581 and 582 are journaled on the ends of bell cranks 583 and 584, respectively, and engage the walls 132 and 133, respectively, prior to engagement of the plow surfaces 578 and 579 with the carton walls 138 and 136, respectively. The bell cranks 583 and 584 are journaled on bolts 586 and 587, respectively, which bolts are secured to pairs of ears 588 (FIG. 46) that are secured to the support plate 574 and project toward the plate 571. The rollers 581 and 582 are urged toward each other by compression springs 591 (FIG. 47) which are disposed between the plate 574 and the other ends of the bell cranks 583 and 584. The springs 591 normally urge the bell cranks 583 and 584 to the positions shown in FIGURE 47 wherein bosses 592 on the bell cranks limit the amount of inward movement permitted the rollers 581 and 582 and maintain the rollers in positions to engage the carton flaps 132 and 133, respectively.

When the forming heads 80 are moved to the active end of the forming stroke as indicated in FIGURE 48, it will be noted that the rollers pivot slightly outwardly against the urging of the springs 591, which springs are of sufficient strength to sharply bend the associated carton walls. It will also be noted that the edges of the heads of mandrels 60 or 61 lie closely adjacent to the flap engaging surfaces 578 and 579 of the plows 572 and 573, and also lie closely adjacent to the flap contacting surfaces of the rollers 581 and 582 thereby assuring that the bottom closure flaps will bend sharply about the score lines 128 alleviating any tendency for the carton walls 132 and 133 to bend outwardly during any subsequent operation on the bottom closure.

BOTTOM HEATER

After the flaps of the bottom closure BC of the cartons on the mandrels 60 and 61 at the bottom forming station S5 has been preformed and assume the position shown in FIGURE 5, the turret 58 (FIGS. 2 and 14) indexes the cartons first at the preliminary bottom heating station S6 wherein the bottom closure flaps are subjected to a preliminary hot air heating step, and thereafter index the carton to the final bottom heating station S7 where the flaps are subjected to a final hot air heating step. The initial heating step at station S6 and final heating step at station S7 combine to raise the temperature of those polyethylene surfaces of the bottom closure flaps which are subsequently sealed together to a bonding temperature which is approximately 800° F.

The bottom heater 84 (FIGS. 49-57) encompasses the two stations S6 and S7, as mentioned above, and includes four identical bottom heating heads 82 which direct hot air only at those surfaces of the bottom closures that are subsequently sealed together. Two of the heads 82 are reciprocated into and out of heating position with the bottom closures BC of the cartons on the upper and lower mandrels 60 and 61 at station S6 while the other two heads simultaneously reciprocate into heating position with the partially heated bottom closures when the cartons are indexed at station S7.

As best shown in FIGURES 49-53, each heating head 82 is bolted to an apertured plate 601 which is welded to one end of a tubular shaft 602. Two tubular shafts 602 are slidably received in upstanding walls 603 and 604 of a bottom heater sub-frame 606, with the axis of one shaft being in alignment with the particular mandrel 60 at station S6 while the other shaft is in alignment with the mandrel 61 that is indexed at station S6. Similarly, the other two tubular shafts 602 are slidably received in the walls 603 (FIG. 51) and 604 and are in alignment with the longitudinal axes of the upper mandrel 60 and lower mandrel 61 that are indexed at station S7. The two shafts

602 at station S6 are interconnected by a vertically extending stub shaft 607 which is received in adjacent hubs formed in split blocks 608 and 609 that are rigidly secured to the upper and lower tubular shafts 602, respectively, at station S6. Similarly, the shafts 602 at station S7 are connected together by a vertical stub shaft 611 (FIG. 51) that is received by split blocks 612 that are rigidly secured to the shafts 602 at station S7.

The four shafts 602 are simultaneously reciprocated toward and away from the associated mandrels by a cam groove 613 in the aforementioned continuously driven cam 272 (FIGS. 13 and 50). A cam follower 614 is journaled on one end of an actuating lever 616 and is received in groove 613 thereby swinging the lever 616 about the axis of a pivot bolt 618 that pivotally receives the other end of the lever and supports the lever 616 from the floor 619 of the sub-frame 606. Two spaced, vertically extending bearing housings 621 and 622 (FIGS. 50 and 51) which are interconnected by a web 623 are also bolted to the floor 619 of the sub-frame 606 and pivotally receive heating head actuating shafts 624 and 626, respectively. One end of an arm 627 is rigidly secured to a portion of the shaft 624 that projects below the floor 619 of the frame 606. The other end of the arm 627 is pivotally connected to the lever 616 by a link 628. Thus, pivotal movement of the actuating levers 616 also causes pivotal movement of the shaft 624.

The shafts 624 and 626 have meshing gears 29 and 631 of equal size keyed thereon, and accordingly the shafts 624 and 626 pivot equal amounts in opposite directions. Levers 632 and 633 (FIG. 51) are secured to the upper ends of the shafts 624 and 626, respectively, and have forked ends which slidably receive the stub shafts 606 and 611. Accordingly, rotation of the cam 272 through one complete revolution will cause the heating heads to move toward and away from the associated mandrels while the mandrels are indexed at stations S6 and S7 and will permit other mandrels to move into stations S6 and S7 prior to starting another cycle of operation.

Each bottom heating head 82 (FIGS. 52 and 53) comprises a housing 635 which defines a plenum chamber 636 that is secured to the plate 601 by capscrews 637 and has a combination temperature gauge 638 and thermocouple screwed therein to indicate the temperature of the air entering the head 82. The plenum chamber housing 635 includes a skirt 639 that is sealed in airtight engagement against plate 601 and is integral with an end distribution wall 641. The wall 641 is provided with large apertures 642 and 643 near its ends, and with a plurality of smaller apertures 644 between the apertures 642 and 643. An intermediate wall 645 and stiffening ribs 646 are provided to assure that the housing 645 will be of sufficient rigidity. Ports 647 and 648 in the wall 645 establish a free flow of hot air from the tubular shaft 602 into the plenum chamber 636.

The hot air from the plenum chamber 636 flows through apertures 642 and 643 into outer distribution chambers 651 and 652, respectively, which directs air against certain outside surfaces of the bottom closure flaps. Hot air is also directed through the small apertures 644 into an inner chamber 653 which directs the hot air against certain internal surfaces of the bottom closure BC.

The outer distribution chambers 651 and 652 are identical and are each defined by a housing 654 which includes an outer rectangular wall 656, side walls 657 and 658, an end wall 659, an inwardly directed perforated, triangle-shaped distribution wall 661, and two perforated trapezoidal walls 662 and 663, all connected together to define the open ended housing 654. A pair of cap screws 666 are extended through openings in the intermediate wall 645 and are screwed into the end wall 659 to clamp the open end of the housings 654 of the outer distribution chamber 651 and 652 into fluid-tight engagement around the associated apertures 642 and 643 in the end wall 641.

of the plenum chamber 636. Since application of heat to the bottom closure flaps tends to return the flaps to the open-ended rectangular position, spacer bars 667 are welded to the triangle shaped walls 661 to prevent such spreading of the preformed flaps.

As best illustrated in FIGURE 52, the inner chamber 653 is defined by an open-ended housing 668 of generally X-shaped cross-section having an end plate 669 secured to a perforated skirt 671. The housing 668 is clamped against the end wall 641 of the plenum chamber 635 by cap screws 672 which extend through holes in a portion of the intermediate wall 644 and are screwed into a threaded boss formed in the end plate 669 of the housing 668. It will be noted that the location and distribution of the perforations on the skirt 671 of the inner chamber 653, and on the walls 661, 662 and 663 of the outer distribution chambers 651 and 652 are such that hot air will be directed at only those surfaces of the bottom closure BC which are subsequently sealed together. It will also be observed that the shape of the perforated walls of the chambers 651, 652 and 653 conform to the shape of the preformed bottom closure BC.

In order to direct low pressure, hot air at approximately 800° F. to the bottom heating heads 82, the bottom heater 84 includes an air heating and control mechanism 676 (FIGS. 49, 50 and 54 to 57) which receives cool, sterile air from a blower system to be described hereinafter. A volume of low pressure, sterile air in excess of that required by the bottom heating heads 82 is directed from a conduit 677 into an elbow 678 (FIG. 54) past a butterfly valve 679. The butterfly valve 679 is adjusted and is locked in adjusted position to assure that a desired proportion of the air from the low pressure supply enters the mechanism 676. The air then flows into a distribution manifold 681 having a plurality of radial passages 682 therein. Each passage 682 communicates with a tubular heater housing 683 and with a flow control discharge port 684. Each discharge port 684 is partially closed by a conical valve 686 that is supported by an adjustment bolt 687 screwed into an upstanding flange 688 of the distribution manifold 681. Each conical valve 686 is spaced a desired amount from the associated discharge port 684 and is locked in adjusted position by a lock nut 689 so as to permit a certain proportion of the air entering the distribution manifold 681 to be discharged past the valves 686 to the atmosphere. Accordingly, the volume of air flowing downwardly within each tubular heating housing 683 and past a heating coil 691 therein, may be controlled with the result that temperature at the heating heads 82 may be maintained at approximately 800° F. Each heating coil, 691 (only one being shown in FIGURE 54) is connected by a conductor 692 to a junction box 693 located at the upper end of the heating and control mechanism 676 and connected to a suitable source of electrical power.

The lower end of each heating housing 683 (FIG. 54) is secured in air tight relation to an associated sleeve 694 formed integrally with the upper wall 696 of an upper distribution housing 697 which defines an annular hot air chamber 698 therein. The upper housing 697 includes a central hub 699 having a cap 701 bolted to its upper end. A vertical shaft 702 (FIG. 54) having a reduced diameter upper portion 703 projecting into the hub 699 and into the cap 701 is provided with a mounting flange 704 that is bolted to a lower wall of a lower distribution housing 706 which serves as a support frame and manifold for the air heating and control mechanism 676. The lower distribution housing 706 also communicates with the upper housing 697 through passages soon to be described and serves as a conduit to direct the hot air to the bottom heaters 82 at stations S6 and S7.

As indicated in FIGURE 49, the lower housing 706 is somewhat triangular in shape, and has one apex supported by and communicating with a rectangular housing 707 that is bolted in fluid-tight engagement through the

wall 604 of the bottom heater sub-frame 606 at station S6. Another apex of the lower housing 706 is supported by and communicates with the rectangular housing 708 that is bolted to the wall 604 at station S7 (FIG. 51). The third apex of the housing 706 is supported by a vertical post 709 secured to a hub 711 of the sub-frame 606 as best illustrated in FIGURE 50. It will be noted that the free ends of the tubular shafts 602 which support the bottom heating heads 82 project into the associated rectangular housings 707 or 708. Thus, all the hot air which enters the lower housing 706 will eventually flow out of the bottom heating heads 82. A thermocouple 712 is inserted into the upper housing 697 to sense the temperature of the air therein.

In order to prevent scorching of cartons positioned at the bottom heating stations S6 and S7 during temporary stops of the bottom forming turret 58, and yet prevent cooling of the heating heads 82 or flow passages to the heads, a rotary control valve 716 (FIGS. 54-57) is provided between the upper distribution housing 697 and the lower distribution housing 706. The rotary control valve 716 comprises a centrally apertured disc 717 (FIG. 54) which is pivotally mounted about an annular lip 718 projecting downwardly from the bottom wall 719 of the upper distribution housing 697 and resting on a nylon disc 721 secured to the upper wall of the lower housing 706. A compression spring 722 is positioned around the reduced portion 703 of the shaft 702 and bears against the cap 701 and a washer 723 supported on a shoulder 724 formed on the shaft 702. The spring 722 serves to support a portion of the weight of the upper housing 697 and parts carried thereby.

As best shown in FIGURE 49, a pneumatic cylinder 726 is pivotally supported by a utility post 727 and has its piston rod 728 pivotally connected to an arm 729 secured to and projecting outwardly from the disc 717. The pneumatic cylinder 726 holds the disc 717 in the position illustrated in FIGURE 55 during normal operation, and shifts the disc 717 to the position shown in FIGURE 56 only when the turret 58 is momentarily stopped. When the disc 717 is held in its normal operating position as indicated in FIGURE 55, short arcuate slots 731 in the disc near its outer periphery are held out of registration with the corresponding slots 732 in the bottom wall 719 of the upper housing 697 and accordingly prevents air from flowing therepast. At this time, all the heated air entering the upper distribution housing 697 flows into the lower housing 706 through a plurality of circular holes 736 in the floor 719 of the upper housing 697, through a plurality of circular holes 737 in the disc 717, and through a plurality of arcuate slots 738 in the nylon disc 721 and in the upper wall of the lower housing 706. When positioned as above-mentioned, the holes 736, 737 and the slots 738 provide unrestricted flow passages from the upper housing 697 to the lower housing 706.

When the carton forming turret 58 is momentarily stopped with carton blanks indexed at the bottom heating stations S6 and S7, the pneumatic cylinder 726 is activated by means to be described hereinafter, thereby shifting the disc 717 to the position shown in FIGURES 56 and 57. Shifting of the disc 717 causes the slots 731 and 732 to register thereby diverting the major portion of the hot air to the outer atmosphere away from the bottom heating heads 82 at stations S6 and S7. However, the holes 737 in the disc 717 remain in partial registration with the holes 736 and slots 738 thereby permitting sufficient hot air to flow through the bottom heating heads 82 to prevent cooling of the heads while maintaining the heads and passages connected thereto at the desired operating temperature. It will be understood, however, that insufficient hot air will be directed against the cartons to scorch or otherwise injure the cartons. Thus, all cartons which are carried out of station S7 upon actuation of the carton forming turret 58 are heated to the desired sealing temperature.

ROLLER PLOWS

After the cartons have been given their final heat treatment at station S7 (FIGS. 2 and 14), they are moved past the roller plows 86 at the bottom folding station S8. While moving past the roller plows 86 at station S8, the bottom closure flaps are gradually folded from substantially horizontal positions into substantially vertical positions so as to be received and subsequently sealed by the preliminary bottom sealer 89 at station S9 and the final bottom sealer 91 at station S10.

The roller plows 86 include a sub-frame 746 (FIG. 14) which is bolted to the frame 160 of the forming section 52 adjacent the arcuate path of movement of the upper mandrels 60 and lower mandrels 61. The sub-frame 746 (FIGS. 58-62) comprises a base 747 having an upstanding inlet bracket 748 and an upstanding outlet bracket 749 welded thereto. Four horizontally disposed, roller supporting bars 751, 752, 753 and 754 are secured to the brackets 748 and 749, the bars 751 and 752 being associated with an upper plow 756 disposed opposite the upper mandrels 60, and the bars 753 and 754 being associated with a lower plow 757 disposed opposite the lower mandrels 61. Since the upper and lower plows are identical, only the upper plow will be described in detail.

An upper stationary deflector 758 (FIGS. 58 and 60) of the upper plow 756 is bolted to an angled surface 759 of the inlet bracket 748 and slidably engages the short flap 138 of the bottom closure BC to assure that the short flap 138 will be folded under the lip 137 of the long flap 136 in proper sealing position. A lower inlet roller 761 is journaled on a bolt 762 secured to another angled surface 763 of the inlet bracket 748, which inlet roller engages the long flap 136 and lies in a plane which is substantially perpendicular to the plane of the long flap.

As best indicated in FIGURES 59-62, a series of lower inclined rollers 764 to 764d are journaled on split blocks 766-766d that are rigidly secured to the lower bar 752, and cooperate with a series of upper rollers 767-767d which are journaled on split blocks 768-768d rigidly secured to the upper bar 751. The cooperating upper and lower rollers progressively spiral from nearly vertical position adjacent the inlet bracket 748 to nearly horizontal positions adjacent the outlet bracket 749 during which time the planes of rotation of the inclined rollers 764 to 764d and 767 to 767d are maintained substantially normal to the planes of the lower and upper carton flaps respectively. A horizontally disposed upper discharge roller 769 (FIG. 62) is journaled on a cap-screw secured to a horizontal surface of the outlet bracket 749, while a similar horizontally disposed lower discharge roller 771 is journaled on a cap-screw 772 which is secured to another horizontal surface of the bracket 749.

Thus, it will be noted that the stationary deflector 758, the upper inclined rollers 767-767d, and the upper discharge roller 769 engage the short flap 138 and gradually deflect it from a substantially horizontal to a substantially vertical position as the turret 58 moves the carton past station S8. At the same time, the long flap 136 is progressively engaged by the inlet roller 761, the lower inclined rollers 764-764d, and the discharge roller 771 which gradually bend the long flap 136 from the horizontal to the vertical position with the lip 137 being disposed outside the short flap 138. It will also be noted that as the end surfaces of the carton are engaged by flap deflecting rollers, that little friction occurs between the flaps and the rollers resulting in an accurate folding operation with little if any tendency for the bottom closure flap to be frictionally forced out of the desired squared position which is necessary for proper sealing.

BOTTOM SEALER

After the heated bottom closure flaps of the cartons have been moved past the rollers plows 86 (FIGS. 2 and

14) at station S8, they are first indexed at station S9 where the heads 88 of a preliminary bottom sealer 89 squeeze the bottom closure flaps against the heads of the associated mandrel 60 or 61 to partially seal the bottom closures BC. The cartons are then advanced to station S10 where the heads 90 of a final bottom sealer 91 apply a final sealing pressure to the bottom closures, which final sealing pressure is localized to certain critical areas so as to partially crush the carton material therebelow and positively block all potential flow or leakage passages in the bottom closure BC.

Since the final bottom sealer 91 is substantially the same as the preliminary bottom sealer 89, only the preliminary sealer will be described in detail and parts of the final sealer 91 which are equivalent to those of the preliminary sealer will be assigned the same numerals followed by the letter *a*.

The preliminary bottom sealer 89 (FIGS. 63 to 66) comprises a sub-frame 776 which is bolted to the frame 160 of the forming section 52. The sub-frame 776 includes a base plate 777 which is integral with a tubular hub 778 and an upstanding bracket 779. A vertically extending, head actuating body 781 is pivotally mounted in the hub 778 on bearings 782 and 783 (FIG. 64), the bearing 783 being held in position on a reduced diameter portion 784 of the body 781 by lock nuts 786. A shroud 787 formed integrally with the body 781 is fitted over the upper end of a tubular hub 778 and is sealed thereto by packing rings 788. An aperture cap 789 is bolted to the lower end of the hub 778 and has an oil seal 791 fitted therein and is rotatably received on the reduced diameter portion 784 of the body 781. The body 781 is pivoted through a predetermined arcuate range relative to the subframe 776 by motion imparted to an actuating lever 792 which is rigidly clamped on the lower end of the reduced diameter portion 784 of the body 781.

A pair of ears 793 are integral with and project outwardly from the side of the body 781 near the upper end thereof. One end of a toggle link 794 is received on a bolt 795 journaled in the ears 793. The other end of a toggle link 794 receives a pivot bolt 796 that is journaled in bearings 797 fitted in a pair of parallel arms 798 of a bell crank 799 (FIG. 66) which includes a hub 801 and a second pair of parallel arms 802 (FIG. 66) projecting outwardly from and formed integrally with the arms 798. The hub 801 of the crank 799 is pivoted about a bolt 803 that is secured to the bracket 779 (FIG. 65) while the free ends of the arms 802 are pivoted on a bolt 804 secured to a sealing head mounting bracket 806 having a control arm 807 formed integrally therewith and projecting outwardly therefrom. The free end of the control arm 807 is pivotally connected by a bolt 808 to one end of a link 809. The other end of the link 809 is pivoted on a reduced diameter stub shaft 811 formed on the upper end of the body 781.

As best shown in FIGURES 63 and 64, the pair of preliminary bottom sealing heads 88 are each secured to the mounting bracket 806 by four bolts 816 which are slidably received in holes in the bracket 806. A compression spring 817 encompasses each bolt and is disposed between the bracket 806 and the associated head 88. The springs 817 urge the associated head 88 outwardly with sufficient force to insure proper sealing of the bottom closure flaps but will yield prior to applying a force strong enough to adversely affect the bottom closure seal. A sealing pressure within the range of 300 to 400 p.s.i. gauge has been found to be adequate to properly seal the bottom closures.

As indicated in FIGURE 64, one head 88 is disposed in alignment with the upper mandrel 60, while the other head 88 is disposed in alignment with lower mandrel 61 at station S9. A flat faced carton engaging press plate 818 (FIG. 68) is bolted to each preliminary sealing head 88 and has beveled lead-in edge 819 which aids in guiding the carton from the roller plows 86 into proper sealing position. Each press plate 818 is provided with a hori-

zontal groove 821 which accommodates the extra wall thickness due to the lip 137 (FIGS. 70 and 72) of the long flap 136 overlapping a portion of the short flap 138.

Since the plates 818 are heated by the hot bottom closure flaps being sealed, cooling water is circulated through passages 822 in each head 88 from supply conduits 823 (FIG. 63) to discharge conduits 824 thereby cooling the heads.

In order to actuate the preliminary bottom sealer 89 and final bottom sealer 91, a double armed bell crank 827 (FIGS. 63 and 67) is pivotally mounted on a vertically extending shouldered shaft 828 which is rigidly secured to and projects downwardly from a bracket 829 by a nut 831 that is screwed on the upper end of the shaft 828. The bracket 829 is bolted to the frame 160 adjacent the previously described, continuously driven cam 822 (FIG. 13).

The bell crank 827 is of two-piece construction and includes a hub 832 which is pivotally mounted on bearings 833 and 834 secured to the shaft 828 by lock nuts 836. A crank arm 837 is formed integrally with the hub 832 and has a cam follower 838 journaled thereon which is received in a cam groove 839 in the cam 288. A cap 841 having arms 842 and 843 (FIG. 63) projecting outwardly therefrom is bolted to the hub 832. An adjustable link 844 (FIG. 63) pivotally connects the arm 842 to the actuating lever 792 of the preliminary sealer 89, while a similar link 846 pivotally connects the arm 843 to the actuating lever 792a of the final sealer 91. Thus, pivotal movement of the bell crank 827 by the cam 288 causes the bottom sealing heads 88 and 90 to be actuated in timed relation with the other components of the forming section 52.

The final bottom sealing heads 90 (FIG. 63) of the final bottom sealer 91, one head being positioned in alignment with the upper mandrel 60 at station S10 and the other head being in alignment with the lower mandrel 61 at station S10, are identical to the preliminary sealing heads 88 with the exception that press plate 848 (FIG. 69) are substituted for the plates 818. Like the plates 818, the plates 848 each have a beveled lead-in edge 849 and a lip accommodating slot 851 therein. The plate 848 is additionally provided with a plurality of raised generally rectangular bosses 852 and circular bosses 853 which partially crush certain critical areas of the bottom closure flaps to block potential flow passages therein arising from the manner in which the bottom closure flaps are folded.

As illustrated in FIGURES 69 to 72, movement of each final sealing head 90 against the bottom closure BC of the associated carton C causes a lip 137 to be received in the slot 851 of the press plate 848 and causes the rectangular bosses 852 and circular bosses 853 to partially crush the carton material along certain fold lines of the bottom closure of the carton. Accordingly, the localized forces affected by the bosses applies a positive indentation in the potential flow areas, which indentations extend transversely across all flow passages in the bottom closure BC resulting in a leak proof bottom closure. In order to firmly resist the sealing pressure applied by the sealing heads, each mandrel includes the previously mentioned flap engaging head 246 with the raised triangular portion 251 on the flap engaging surface. The triangular portion of the head 246 is received opposite the central portion of the lip 137 within a triangular-shaped cavity 854 defined by the flaps 132 and 133 (FIG. 5) which, when folded into sealed position defines double thickness triangle-shaped inner walls 132a and 133a (FIG. 71).

It will be particularly noted that the use of the press plate 818 having a smooth flap engaging face at the preliminary sealing station S9, in combination with the roller plows 86 at stations S8 which sharply folds the bottom closure flaps into sealing positions, permits the bottom closure flaps to be indexed between the press plate 818 and flap-engaging head 246 when the plate and head are quite close together as indicated in FIGURE 63. Thus,

the bottom closure flaps do not separate to any measurable extent when they are released from the roller plows 86 and, accordingly, provide for a better seal. Similar close tolerances are maintained between the mandrel head 246 and the press plate 848 at station S10 when the final bottom sealer 91 is in the inactive position shown in FIGURE 63.

When the preliminary bottom sealer 89 is in the active position of FIGURE 66, the sealer 89 is adjusted so that a clearance of approximately 0.35 inch is present between the plate 818 and the raised triangular portion 251 of the mandrel head 246 when no cartons are present on the mandrel. When a carton is present on the mandrel, the spacing between the plate 818 and the mandrel head 246 is determined by the wall thickness of the bottom closure flaps disposed therebetween. The springs 817 obviously are provided so as to accommodate different flap thicknesses. It will be understood that similar tolerances are present at station S10 between the mandrel head 246 and the press plate 848. It will also be noted that during application of sealing pressure, the linkages are arranged so that the axes of bolts 795, 796 and 804 lie in a common plane thereby substantially locking the heads in sealing position eliminating the need for prolonged sealing forces being applied directly from the cam 288.

Upon release of the pressure of the final sealing heads 90, the cartons are moved out of station S10 to the unloading station S11 with the bottom closure BC sealed as indicated in FIGURE 72.

MANDREL UNLOADING MECHANISM

After the final sealing operation has been performed upon the bottom closure BC at station S10 (FIGS. 2, 14 and 73), the turret 58 indexes the cartons C at the unloading station S11. While at the unloading station S11, the unloading mechanism 92 simultaneously withdraws the the cartons from the upper mandrel 60 and lower mandrel 61 and moves the upper carton into position to be deflected into the first accumulator conveyor 64 of the sterilizing and accumulating section 56 while moving the lower carton to an intermediate position below the upper carton. The intermittently driven turret 58 is then actuated to position another set of cartons at station S11 permitting the unloading mechanism 92 to withdraw the second set of cartons from the mandrel 60 and 61 and position them as above described. At the same time, the mechanism 92 moves the first mentioned lower carton from the intermediate position into a position to be directed into the second accumulator conveyor 62 of the sterilizing and accumulating section 56.

The unloading mechanism 92 (FIGS. 73-81) comprises a mandral unloading carrier 861 and a carton transfer carrier 862 which carriers are slidably mounted on the shaft 863. The shaft 863 (FIGS. 73 and 74) is supported a short distance above the frame 160 of the form section 52 pedestals 864 and 866, the pedestal 866 being disposed below the path of movement of the lower mandrels 61. The carriers 861 and 862 are held from rotation about the shaft 863 by cam followers 867 and 868, respectively, journaled thereon and slidably received between spaced plates 869 and 871 (FIG. 75) which define a cam track 872. The plates 869 and 871 are held in spaced parallel relationship to each other and to the shaft 863 by cap screws 873 which extend through the plates, through spacers 874, through pedestals 876 and are screwed into the frame 160.

The mandrel unloading carrier 861 is generally L-shaped (FIG. 77) and has a lower horizontal portion 877 to which the cam follower 867 is journaled and includes a vertical arm 878 projecting upwardly from the shaft 863. Four carton engaging stripper fingers 879, 881, 882 and 883 are pivotally mounted on the vertical arm 878, the fingers 79 and 881 cooperating to strip the carton from the upper mandrel 60 which is indexed at station S11

and the fingers 882 and 883 cooperating to strip the carton from each lower mandrel 61 when at station S11.

The carton transfer carrier 862 (FIG. 78) has a single stripper finger 884 pivotally mounted thereon and disposed in position to engage the lowermost wall of the lower carton and move the carton from the aforementioned intermediate position into the position to be deflected into the second accumulator conveyor 64.

Since each of the stripper fingers are identical, the description of the stripper finger 879 (FIGS. 79 to 81) will suffice for all.

The finger 879 is pivoted on a bushing 886 (FIG. 81) which is disposed between collars 887 and 888 and clamped rigidly thereagainst by a bolt 889 secured to the vertical arm 87 of the carrier 861. A torsion spring 891 has one end connected to the collar 887 and the other end connected to the hub 892 of the finger 879 and urges the finger into the position shown in FIGURE 79 wherein a carton engaging surface 893 is disposed in position to engage a carton on the mandrel 60 at station S11. An abutment surface 894 of the finger 879 is normally urged against a boss 896 on the vertical arm 878 of the carrier 861. Thus, when the unloading carrier 861 is moved to the left as viewed in FIGURE 79, the carton engaging surfaces 893 of the fingers 879 and 881 will engage adjacent edges of flaps of the top closure TC of the carton C and will strip the carton from the mandrel 60. It will be noted that the fingers 879 and 881 will pass through the previously described slots in the mandrel 60 and will at no time contact any surface of the mandrel 60.

Prior to returning the reciprocable carrier 861 to the active stripping position shown in FIGURE 79, another mandrel 60 is indexed into station S11. When the carrier 861 is returning to the active position, the surfaces 893a of the fingers 879 and 881 will engage the carton on the mandrel 60 and will pivot the fingers 879 and 881, against the urging of the torsion springs 891, to positions which will permit the fingers to slide over the upper and lower walls, respectively, of the carton until they move free of the carton and snap into the active position shown in FIGURES 79 and 80. It will be apparent that the fingers 882 and 883 operate in an identical manner on the carton disposed on the lower mandrel at station S11, and that the finger 884 on the transfer carrier 862 operates in a similar manner during reciprocation of the carrier 862.

In order to reciprocate the carriers 861 and 862 in timed relation with the movement of the turret 58 and other components of the forming section 52, in timed relation with the conveyors 62 and 64 of the sterilizing and accumulating section 56, the pivotal motion of the previously mentioned shaft 529 (FIGS. 13 and 27) of the upper loader 74 is employed to drive the mandrel unloading mechanism 92. A crank arm 898 is rigidly secured to the shaft 529 and is pivotally connected to one end of an adjustable link 899. The other end of the link 899 is pivotally connected to an arm 901 which is secured to a vertical extending pivot shaft 902. The shaft 902 (FIGS. 73 and 74) is pivotally mounted in bearings in the frame 160 and has a carrier actuating arm 903 secured on its upper end.

The carton transfer carrier 862, which carrier need not be adjusted to accommodate the four different carton sizes, is pivotally connected to the free end of the carrier actuating arm 903 by an adjustable link 904. When the turret 58 and accumulator 65 are adjustable to handle quart size cartons as indicated in FIGURES 73 and 74, the mandrel unloading carrier 861 pivotally connected to one end of an adjustable link 906. The other end of the link 906 is connected by a pivot pin 907 to a yoke 908 formed adjacent the free end of the arm 903.

Although the transfer carrier 862 need not be adjusted to accommodate the several different sizes of cartons because the top closures TC all sizes of cartons will be

deposited at the same location when advanced by the carrier 862 into position to be loaded into the second accumulator conveyor 64, it will be appreciated that the mandrel unloading carrier 861 must be adjusted to accommodate each size of carton so as to position the top closures thereof in common location when the cartons are in position to be loaded into the accumulator conveyors 62 and 64. Accordingly, a second yoke 909 is secured to the arm 903 and is arranged to selectively receive the pivot pin 907 in a one-half pin aperture 911, a one-third quart aperture 912, or a pint aperture 913. Thus, when cartons other than quart cartons are being processed, the link 906 is pivotally connected to the appropriate aperture 911, 912 or 913 by the pin 907.

Since it is imperative that the vertical arm 878 of the mandrel unloading carrier 861 be moved outwardly of the free end of the mandrels 60 and 61 prior to the indexing of the mandrels, a protective chain link 914 covered by a flexible tube 916 is permanently fixed between the carriers 861 and 862. The link 914 is of sufficient length to draw the carrier 861 out of the path of movement of the mandrels in the event that an operator neglects to attach the free end of the link 906 to one of the yokes 908 or 909.

ACCUMULATOR

After the cartons C have their bottom closures BC sealed and have been withdrawn from the mandrels 60 and 61 (FIGS. 1 and 2) of the forming section 52 by the mandrel unloading mechanism at station S11, they are received in two rows at station S12 of the sterilizing and accumulating section 56. When transferred into the section 56, the cartons are disposed in positions to be fed into either the first accumulator conveyor 64 or the second accumulator conveyor 62. Continuously driven conveyor loading rotors 921 and 922 (FIGS. 75, 82 and 83) then transfer the cartons into the first conveyors 64 and second conveyor 62 while rotating each carton 90° about its longitudinal axis. The conveyors 62 and 64 move the cartons upwardly past the plurality of ultraviolet lights 94 at station S12 which sterilizes the cartons by subjecting the carton to ultraviolet light for approximately 4.3 seconds and thereafter discharges the cartons into the accumulator guideways 66, each of which accumulates a stack of cartons for subsequent acceptance by the filling or wet section 54. Accordingly, the accumulator 65 permits the forming or dry section 52 and the filling or wet section 54 to operate independently of each other.

As shown in FIGURES 74, 75, 76, 82, 83 and 84, the cartons withdrawn from the upper mandrels 60 are received in an upper trough 923 which has a longitudinally extending slot 924 in the floor 926 of the trough adjacent its inlet end to permit the finger 881 to pass therethrough as indicated in FIGURE 76. A plurality of transverse slots 927 are formed in the floor 926, in an inner wall 928, and in an arcuate extension 929 of the wall 927 so as to accommodate spaced transfer fingers 930 of the upper loading rotor 921 which loads the upper cartons into carriers 931 of the first accumulator conveyor 64 as indicated in FIGURE 75. The trough 923 is secured by brackets 932 and 933 (FIG. 76) formed integrally therewith to upstanding legs 934 and 936 of an accumulator frame 937. In order to guide each top closure TC of the carton as it is being moved out of the upper trough 923 and into the carrier 931 of the first accumulator conveyor 64, a vertically extending guide plate 938 includes a lower mounting flange 939 (FIG. 76) which is bolted to the frame leg 936 and limits axial movement of the cartons to the right. The guide plate 938 includes an upper arcuate flange 941 which engages the carton top closure TC and prevents outward radial movement of the carton about the axis of the rotor 921 as it is being moved into the carrier.

An arcuate, longitudinally adjustable carton guide 942 is positioned to engage the bottom closure of the carton

and cooperates with the plate 938 and flange 941 to prevent longitudinal and radial movement of the carton as it is transferred onto the carriers 931. It will be appreciated that the guide 942 must be longitudinally adjustable in order to selectively accommodate the four different sizes of cartons. The upper end of the guide 942 is secured to an adjustable track supporting carrier 944 (FIGS. 75, 83 and 85) which carrier will be described in more detail hereinafter.

The cartons withdrawn from the lower mandrels 61 are received in a trough 946 (FIGS. 75, 76 and 83) which is quite similar to the trough 923 but extends to a position opposite the second accumulator conveyor 62. The floor 947 of the trough 946 is provided with a longitudinal slot 948 to accommodate the unloader and transfer fingers 883 and 884 as illustrated in FIGURE 76. Like the trough 923, a portion of the floor 947, an inner wall 949 and an arcuate extension 951 of the inner wall are transversely slotted at 952 to receive fingers 953 of the lower loading rotor 922. A top closure guide 954 which is similar to the guide 942 is bolted to an upstanding leg 956 (FIGS. 75 and 76) of the frame 937 and includes an arcuate carton guiding flange 957. An adjustable arcuate carton guide 958 of L-shaped section is provided to stop the bottom closure in proper position and to cooperate with the guide 954 to guide each carton onto a carrier 959 of the second accumulator conveyor 62 during transfer of the carton from the trough 946 to the carrier 959. As indicated in FIGURES 76 and 82 the upper surface of the lower carton is guided into the aforementioned intermediate position on the trough 946 by a pair of spaced guide rails 961 and 962 that are rigidly secured to the frame 937. Each lower carton is held in the intermediate position during movement of the finger 884 there passed by spring clamps 966 and 967 that are supported by the rails 961 and 962.

The loading rotor 921 which effects transfer of the cartons from the upper trough 923 to one of the carriers 931 on the first accumulator conveyor 64 is keyed to a shaft 968 (FIGS. 75 and 83) that is journaled in the legs 934 and 936 of the frame 937. Each of the spaced transfer fingers 930 of the rotor 921 has a pair of right angle pockets 969 therein for receiving the cartons during the transfer operation. It will be apparent that the rotor 921 transfers two cartons onto two adjacent carriers of the conveyor 64 during each rotation of the rotor 921. Similarly, the rotor 922 is mounted on a shaft 971 journaled in the legs 934 and 956 of the frame 937. The fingers 953 of the rotor 922 are each provided with a pair of right angle pockets 972 so as to accommodate each lower carton. As clearly indicated in FIGURE 84, the accumulator conveyor carriers 931 and 959 are each slotted to accommodate the free ends of the curved extensions 929 and 952, respectively, of the upper and lower troughs thereby assuring that the cartons will be transferred into the associated carriers 931 and 959.

The accumulator conveyors 62 and 64 are supported by the frame 937 which includes a tubular pedestal 976 (FIG. 82) which has a right angle bear box 977 bolted to its upper end. The right angle bear box 977 includes two concentric horizontally disposed output shafts 978 projecting outwardly from opposite sides thereof. A drive sprocket 979 (only one being shown in FIGURE 82) is secured to each output shaft 978, and one sprocket drives an endless chain 981 of the conveyor 64, while the other sprocket 979 drives the chain 982 of the conveyor 82. The lower portions of the chains 981 and 982 (FIG. 84) are trained around idler sprockets 983 and 984, respectively, which are keyed to shafts 986 and 987, respectively, that are suitably journaled in the frame 937.

The accumulator conveyors 62 and 64, the upper loading rotor 921, and the lower loading rotor 982, are continuously driven from the previously described continuously driven right angle gear box 291 (FIGS. 13 and 82) of the forming section 52. The vertically extending output

shaft 988 (FIG. 82) of the gear box 291 is connected to the downwardly extending input shaft 989 at the upper end of the accumulator by a vertically elongated shaft 991 and flexible coupling 992 thereby driving the conveyors 62 and 64 in a clockwise direction as viewed in FIGURE 82.

The lower loading rotor 922 is driven by an endless chain 993 (FIGS. 75 and 84) which is trained around a drive sprocket 994 secured to the conveyor shaft 987, a driven sprocket 996 secured to the rotor shaft 971 and a pair of take-up sprockets 997 adjustably secured to the leg 956 of the accumulator frame 937. The upper loading rotor 921 is driven from the lower rotor 922 by a gear train which includes a drive gear 998 (FIGS. 74 and 75) secured to the shaft 971, and idler gear 999 journaled on a bolt 1001 secured to the central leg 934 of the frame 937, and a driven gear 1002 secured to the shaft 968 of the upper rotor 921. Thus, the rotors 921 and 922 are driven in a clockwise direction (FIG. 75) and in timed relation with the accumulator conveyors 62 and 64 and with the operative components of the forming section 52.

It will be appreciated that the ultraviolet lights 94 (FIGS. 82 and 85) of the sterilizing station S12 must be shielded in order to protect the operator's eyes from the injurious rays emitted from the light. Accordingly, an open ended tubular housing 1006 of generally rectangular shape has its rear wall 1007 bolted to the accumulator frame 937. The housing is disposed around the lights 94 and also around the upwardly moving runs of the conveyors 62 and 64. In order to easily gain access to the sterilizing area, a front wall 1008 of the housing 1006 is cut away intermediate its upper and lower ends to provide a larger opening 1009 therein which is normally closed by a door 1010 that is hinged at 1011 and is held in the closed position by a latch 1012 of a standard design. Each ultraviolet light 94 is supported in a relatively small box-like housing 1013 which is open at the left side (FIG. 85) adjacent to the open top closures TC of cartons passing thereby so that the light will enter the cartons and will sterilize the same. The box-like housings 1013 are mounted on brackets 1014 secured to the rear wall 1007.

In order to maintain complete control of the cartons as they move upwardly past the ultraviolet lights 94, the carriers 931 and 959 of the accumulator conveyors 62 and 64, respectively, each have a pair of rollers 1016 and 1017 journaled thereon, and also have spaced fingers 1018 and 1019 projecting outwardly therefrom. Vertically extending guide rails 1020 are bolted to the rear wall 1007 of the housing 1006 and are disposed between fingers 1018 and 1019 of the associated carriers 931 or 959 to prevent movement of the carriers longitudinally of the cartons. The rollers 1016 and 1017 of the carriers 931 are received in vertically extending tracks 1021 and 1022, respectively, that are bolted to the rear wall 1007, while the rollers 1016 and 1017 of the carriers 959 are similarly received in vertically extending tracks 1023 and 1024 bolted to the wall 1007. It will be apparent that the tracks hold the associated carriers from movement toward or away from the cartons.

The cartons on the carriers 931 when moving upwardly by the conveyor 64 have their top closures TC guided by a fixed vertically extending angle guide track 1026 and have their bottom closures guided by an adjustable angle guide track 1027. Similarly, the cartons on carriers 959 of the conveyor 62 have their top closures guided by a vertically extending fixed track 1028 and have their bottom closures guided by a vertically extending adjustable track 1029. The fixed tracks 1026 and 1028 are bolted to the front wall 1008 having spacers 1031 disposed therebetween.

The adjustable tracks 1027 and 1029 are secured to and form a part of the previously mentioned tracks supporting carriers 944 (FIGS. 83, and 85-88) which carrier has the adjustable arcuate guides 942 and 958 bolted thereto. As best shown in FIGURES 86 and 87, the arcuate

guide 942 is secured to and forms a continuation of the track 1027, while the guide 958 is secured to and forms a continuation of the track 1029. The tracks 1027 and 1029 are connected together by an upper strap 1032 and a lower strap 1033 by capscrews 1034 which extend through tubular spacers 1036 having a reduced diameter neck 1037 (FIG. 88) formed therein. The carrier 944 is adjustably supported by the spacers 1036 each of which is slidably received in an L-shaped slot 1038. Each slot 1038 includes a large diameter opening 1039 which is of sufficient size to accommodate the largest diameter of the spacer 1036. The opening 1039 communicates with a narrow horizontal portion 1042 which slidably receives the circumferential neck 1037 in the spacer. Each of the horizontal portions 1042 has four arcuate recesses 1043, 1044, 1046 and 1047 in its lower surface, which, when the neck 1037 is seated therein, positions the arcuate guides 942 and 958 and the tracks 1027 and 1029 in positions to handle quart, pint, one-third quart and one-half pint cartons, respectively.

After the cartons have been sterilized and have been moved upwardly out of the sterilizing station S12, they are guided around the upper sprockets 979 (FIG. 82) and gravitate into the accumulator guideways 66. A stack of cartons is accumulated in each guideway so that the lower carton in each stack may be periodically removed therefrom as required by and upon demand from the filling section 54.

The accumulator guideways 66 (FIGS. 82, 85, 89 and 90) are provided for receiving the rows of cartons from the conveyors 62 and 64. The guideways 66 are supported primarily from the tubular pedestal 976 by an upper bracket 1051 and a lower bracket 1052. Transversely extending, horizontally disposed bars 1053 are bolted to each bracket 1051 and 1052 and a vertical plate 1054 is secured to the bars 1053 by bolts 1056 and cooperating spacers 1057 disposed between the plate and bars.

In order to guide the top closures TC of the carton C carried by and discharged from the accumulator conveyor 64, a stationary track 1058 is formed by a pair of bars 1059 and 1061 (FIGS. 85 and 90) held in spaced relation from each other by spacers 1062 and secured to the plate 1054 by the bolts 1056. As illustrated in FIGURE 85, the wide lip 153 of the carton top closure flap 142 of each carton C is received between the bars 1059 and 1061 so as to maintain control of the cartons during their movement. Similarly, a stationary track 1063 formed by rails 1064 and 1066 and separated by spacers 1067 is connected to the plate 1054 and receives the wide lip 153 of each carton C advanced therethrough by the conveyor 62.

In order to guide the bottom closures of the cartons and to adapt the guideways to selectively handle the four sizes of cartons, adjustable tracks 1068 and 1069 are adapted to slidably receive the bottom closures of the cartons advanced by the conveyors 64 and 62, respectively. The track 1068 and 1069 each comprises a pair of wide rails 1071 and 1072 which engage opposite sides of the cartons adjacent the bottom closure BC and prevent transverse movement thereof, and an intermediate short rail 1073 which engages the bottom surface of the carton and cooperates with the associated stationary track 1058 or 1059 to prevent longitudinal movement of the carton as the carton moves therpast.

The rails 1071, 1072 and 1073 of each track 1068 and 1069 are held in parallel spaced relationship by a plurality of spacers 1074 and cooperating bolts 1075 which rigidly connect the track 1068 to a track adjustment carrier 1076 (FIGS. 89 and 90). The carrier 1076 is rigidly constructed and includes a pair of spaced, vertically extending bars 1077 and 1078 rigidly secured to a pair of identical horizontal bars 1079, only one bar 1079 being shown in detail in FIGURE 90. An upper pair of grooved rollers 1081 are journaled by capscrews 1083 between opposite ends of the upper horizontal bars 1079 and an

upper latch supporting plate 1084. Similarly, a lower pair of grooved rollers 1086 are journaled by capscrews 1087 between opposite ends of the lower bar 1079 and a lower latch support plate 1088. As best shown in FIGURE 89, the upper rollers 1081 are slidably received in slots 1089 and 1091 in a horizontal plate 1092 while the lower rollers 1086 are similarly received in horizontal slots 1093 and 1094 in a plate 1096. The plates 1092 and 1096 are connected by the aforementioned bolts 1056 and cooperating spacers 1097 to the plate 1054 which is provided with slots corresponding to the slots 1089, 1091, 1093 and 1094 to permit passage of a portion of the rollers therethrough.

A latching device 1098, such as a spring loaded detent of any well-known type, is supported by each latch support plate 1084 and 1088. Each latching device 1098 (FIG. 89) includes a pin 1099 which is selectively received in holes 1101, 1102, 1103 or 1104 formed in the associated plates 1092 and 1096 to lock the track adjusting carrier 1076 in the quart, pint, one-third quart, and one-half pint positions, respectively.

As indicated in FIGURES 85, 89 and 90, the adjustable tracks 1068 and 1069 curve around the upper ends of the conveyors 64 and 62 and form continuations of the movable tracks 1027 and 1029, respectively.

Grooved rollers 1106 (FIGS. 82, 86 and 88) are journaled on a bar 1106a secured to the ends of the tracks 1068 and 1069 and are rotatably received on a V-shaped track 1107 secured to the upper end of the front wall 1008 of the tubular housing 1006. The rollers 1106 assure that the carton will be accepted by the tracks 1068 and 1069 without interference. As will be explained in more detail later, three photoelectric cells 1108, 1109 and 1111 (FIG. 82) are secured in vertically spaced fixed positions to angle brackets 1112 secured to each stationary track 1058 and 1063 (FIG. 85) and cooperate with light sources 1113, 1114, and 1116 secured to the plate 1054 for the purpose of detecting the presence or absence of cartons in the accumulator guideways 66 and for interrupting the operation of the filling section 54 if the supply of cartons is not sufficient. The photoelectric cells 1111 are activated when less than three cartons are present in the associated guideways, the photoelectric cells 1109 are activated when more than approximately ten cartons are in the associated guideways, and the photoelectric cells 1108 are activated when more than approximately 16 cartons are in the associated guideways. It is to be understood, however, that the positions of the photoelectric cells and light sources may be changed so as to accumulate a greater or lesser number of cartons if desired.

FILLING SECTION CONVEYOR AND CARTON SIZE ADJUSTMENT

As mentioned previously, the filling section 54 (FIG. 1) is operated independently of the forming section 52 and independent of the accumulating section 56. The filling section 54 is provided with its own drive, which is independent of the drive for the forming section 52 and of the accumulating section 56, and if desired, may be operated when the operative components of the drive section and the accumulator conveyors 62 and 64 are not in motion provided a sufficient number of cartons are present in the accumulator guideways 66.

All of the components of the filling section 54 (FIGS. 91, 92 and 93) are carried by a stationary frame 1132 having feet 1133 which may be adjusted to maintain the stationary frame 1132 in a horizontal plane. The stationary frame 1132 is attached to the frame 160 (FIG. 13) of the forming section 52 by the aforementioned adjustable links 159.

In order to accommodate all four sizes of cartons, a vertically adjustable frame 1137 is mounted on four screw jacks 1138, 1139, 1140 and 1141 of standard well-known design. Each screw jack includes a housing 1142, which housing is rigidly secured to the stationary frame 1132,

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and a vertically movable shaft 1143 which is actuated upon rotation of a horizontal shaft 1144 journaled in and extending outwardly from both sides of the housing 1142. The upper end of each vertical shaft 1143 is connected to the adjustable frame 1137, and accordingly, vertical movement of the shafts 1143 will cause the adjustable frame 1137 to move vertically.

As shown in FIGURE 91, an air motor 1145 is supported by the stationary frame 1132 and is connected by a flexible coupling 1146 to the input shaft of a right-angle gear box 1147. The output shafts 1148 and 1149 of the gear box 1147 are connected by flexible couplings 1151, cooperating line shafts 1152, and right angle gear boxes 1153 to the horizontal shafts 1144 of each screw jack 1138, 1139, 1140 and 1141 thereby assuring that the movable frame 1137 will be maintained horizontal during actuation of the jacks.

For accurately determining the amount of movement imparted to the adjustable frame 1137, the horizontal shaft 1144 of the gear box 1141 (FIG. 92) is connected to a gear box 1156 which is, in turn, connected to a counter 1157 that is calibrated to measure the vertical movement of the adjustable frame 1137 in thousandths of an inch.

As will be described in more detail hereinafter, the stationary frame 1132 has bolted thereto stationary columns 1171, 1172, 1173, 1174, 1175, 1176 and 1177 which define the vertical axes of rotation for the crimping turret 98, the top forming turret 100, the no-carton no-fill turret 102, the filling turret 104, the top heating turret 106, the top sealing turret 108, and the marking turret 110 respectively. Tubular turret drive columns 1179, 1181, 1182, 1183, 1184, 1186 and 1187 are journaled about stationary columns 1171, 1172, 1173, 1174, 1175, 1176, and 1177, respectively, and turret drive sprockets 1188, 1189, 1191, 1192, 1193, 1194, and 1196 are connected to the tubular turret drive columns 1171, 1172, 1173, 1174, 1175, 1176 and 1177, respectively, for rotation therewith but are mounted for vertical sliding movement relative to the associated tubular columns. Additionally, each turret drive sprocket is connected to the adjustable frame 1137 for rotation relative thereto and for vertical movement therewith.

A carton transport conveyor chain 1201 (FIGS. 91 and 94) of carton transport conveyor 68 (FIGS. 1 and 2) is trained around the sprocket 1188, 1189, 1191, 1192, 1193, 1194 and 1196. The transport conveyor chain is also trained around an idler sprocket 1202 that is journaled on a shaft 1203 secured to the adjustable frame 1137, around a drive sprocket 1204 for the discharge conveyor 112, and around a take-up sprocket 1206. The discharge conveyor drive sprocket 1204 is keyed to a shaft 1207 journaled on the adjustable frame, while the take-up sprocket 1206 is journaled on one end of a bell crank 1209. The bell crank 1209 is journaled on the adjustable frame and has its other end pivotally connected to one end of a link 1211. The other end of the link is slidably received in a boss 1212 and is held in adjusted position by lock nuts 1213 and a spring 1214.

A drive train 1216 for the filling section 54 (FIGS. 91 and 92) is mounted on a downwardly projecting platform 1217 of the movable frame 1137. The drive train comprises a motor 4M which includes a magnetic brake for instant stopping when de-energized and has a fluid coupling 1219 secured to its output shaft 1221 to start the conveyor chain 1201 smoothly upon energization of the motor 4M. The fluid coupling 1219 may be a Number 6D Dodge Flexidyne drive as disclosed in Manual X693E and as manufactured by Dodge Manufacturing Corporation, Mishawaka, Ind. A drive pulley 1222 keyed to the output of the fluid coupling 1219 is connected by V-belts 1223 to drive pulleys 1224 of a variable speed driving unit 1226. The variable speed driving unit 1226 includes a drive pulley 1227, a driven pulley 1228, a drive belt 1229 and a hand wheel 1231 for varying

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the pitch diameter of the pulleys 1227 and 1228. The variable drive unit 1226 may be of the type manufactured by Reliance Electric and Engineering Co., Reeves Pulley Division, Columbus, Ind. The pulley 1228 is connected to the input shaft 1232 of a gear box 1233 which has a drive sprocket 1234 keyed on its vertically extending output shaft 1235. A drive chain 1236 is trained around the sprocket 1234, around a sprocket 1237 rigidly connected to and of the same diameter as the sprocket 1194, and around a take-up sprocket 1238. The take-up sprocket is journaled on a shaft 1239 which is supported by the movable frame 1137 and is held in adjusted position by a line 1241 connected to an apertured boss 1242 of the frame 1137. During normal operation, the drive train continuously drives the transport conveyor chain 1201 and the several turrets of the filling section which are driven thereby.

As indicated in FIGURE 94, the carton transport conveyor chain 1201 is of double chain construction and has a plurality of carton carries 1246 secured thereto. Each carrier 1246 includes a floor plate 1247 having three upstanding walls 1248, 1249 and 1251 formed integrally therewith. A strap 1252 is welded to the walls to strengthen the same.

It will be apparent that the only adjustment necessary to adapt the wet or filling section 54 to handle the four different carton sizes is to move the movable frame 1137 and the transport conveyor 68 (FIGS. 1 and 2) as a unit to an appropriate height wherein the floor 1247 of each carrier 1246 will support the top closure of the associated carton at the proper elevation. Thus, the top closures of all sizes of cartons are maintained at the same elevation when being operated upon by the several components of the filling section 54.

CARTON FEED MECHANISM

After the bottom closures BC of the cartons C (FIG. 1) have been sealed and the cartons have been stacked in the two accumulator guideways 66 at station S13, the lowermost carton in each guideway is pushed by the carton feed mechanism 96 (FIGS. 95 to 99) at station S14 out of the associated guideway 66. At this time, the carton is deflected from a horizontal to a vertical position and is then pivoted 90° about its longitudinal axis and is pushed into pickup positions above the path of movement of the carriers 1246 of the continuously driven transport conveyor chain 1201 while the carriers are being moved around the crimping turret 98 at the crimping station S15 (FIGS. 95-107).

The carton feed mechanism 96 (FIGS. 95 and 96) at station S14 includes a pair of carton deflecting chutes 1263 and 1264 each of which is associated with one of the accumulator guideways 66. Each chute comprises a substantially horizontal floor plate 1266 disposed below the associated guideway 66 which acts as a support for the column of cartons in the guideway 66 and is formed integrally with a vertically extending rear wall 1267. A similar vertically extending front wall 1268 is connected to the rear wall 1267 by a vertical side wall 1269 and a curved side wall 1271. The four walls cooperate to define a carton deflecting passageway 1272 which guides the carton as it slides down the curved wall 1271 to a vertical position with its top closure TC uppermost.

The chutes 1263 and 1264 are bolted to straps 1273 and 1274 which, in turn, are bolted to a bracket 1276. The bracket 1276 is bolted to the frame 937 of the accumulator 65 as illustrated in FIGURE 82.

In order to deflect cartons into the deflecting passageways 1272 of the chute 1263 and 1264, carton pushers 1277 and 1278 are provided for pushing the lowermost carton in the associated guideways 66 off the floor plate 1266 and into the passageways 1272 of the chutes 1263 and 1264, respectively. Each carton pusher 1277 and 1278 comprises a bell crank 1279 pivoted on a shaft 1281

secured to the bracket 1276 and held from axial movement by collars 1282. A pusher foot 1283 is bolted to the upper end of each bell crank 1279, and downwardly extending links 1284 and 1286 are pivotally connected to the other end of the bell crank 1279 of pushers 1277 and 1278, respectively.

The lower ends of the links 1284 and 1286 are slidably received in a block 1287 (FIGS. 95 and 97) that is pivoted in the yoke 1288 formed on one end of an actuating lever 1289 that is pivoted at its other end about a bolt 1291 (FIG. 95) which is connected to a bracket 1292 secured to the stationary frame 1132. Compression springs 1293 are disposed around the links 1284 and 1286 and between the block 1287 and collars 1294 keyed to the links 1284 and 1286. Thus, upward movement of the block 1287 will normally cause both pushers 1277 and 1278 to deflect cartons into the associated chutes 1263 and 1264. The block 1287 is vertically reciprocated in timed relation with the movement of the transport conveyor chain 1201 by a cam 1296 which is splined on the lower end of a vertical camshaft 1297 for rotation therewith and for vertical movement relative thereto. The cam 1296 is held from vertical movement between an upper horizontal portion 1298 and a lower horizontal portion 1299 of the bracket 1292. A cam follower 1301 journaled on the lever 1289 engages a cam groove 1302 in the cam 1296 to cause vertical reciprocation of the block 1287.

A feature of the invention is to provide means for deactivating one or both of the pushers 1277 and 1278 in the event the supply of cartons in one or both of the associated accumulator guideways 66 (FIG. 82) is low as determined by the aforementioned photoelectric cells 1111. If the supply of cartons is low in only one of the guideways 66, it will be understood that the pusher associated therewith will be inactivated while the other pusher operates in a normal manner.

As best shown in FIGURES 95 and 96, bolts 1303 and 1304 extend through the lower ends of the links 1284 and 1286, respectively, in positions to be engaged by hooking notches 1306. The notches 1306 are formed in the upper ends of spaced latching arms 1307 and 1308 of bellcranks 1309 and 1311, respectively. The bellcranks are journaled on a shaft 1312 that is secured to the lower portion 1299 of the bracket 1292. The bellcrank 1309 is pivotally connected to the actuating element 1313 of a solenoid 1314, which solenoid during normal operation is energized to hold the latching arms 1307 out of engagement with the bolts 1303 as indicated in FIGURE 95. Similarly, the bellcrank 1311 is pivotally connected to the actuating element 1316 of a solenoid 1317 which is energized to hold the latching arms 1308 out of engagement with the bolt 1304 during normal operation of the machine. A normally open cam switch 5CS (FIGS. 84 and 95) is held closed, and a normally closed cam switch 6CS is held open by a switch actuating element 1320 that is bolted to the block 1287 when the parts are in the retracted position indicated in FIGURE 95.

When the supply of cartons is low in one of the accumulator guideways 66, for example, the guideway associated with the pusher 1277, the solenoid 1314 will be de-energized causing the latching arms 1307 to engage the bolt 1303 and prevent the link 1284 from moving upwardly thereby de-activating the pusher 1277. It will be appreciated that the spring 1293 will yield to permit the block 1297 to be reciprocated in the usual manner by the cam 1296 thereby causing the pusher 1278 to operate in the normal manner while pusher 1277 is held from movement by the latching arms 1307.

The camshaft 1297 is rotatably journaled in bearings 1318 and 1319 (FIG. 96) in horizontal members 1321 and 1322, respectively, of a vertically movable feed mechanism sub-frame 1324. The upper end of the shaft 1297 is threaded and is held from vertical movement relative to the frame 1324 by a nut 1326 and cooperating thrust washer 1327. The sub-frame 1324 is of generally rec-

tangular configuration and includes vertical side members 1328 and 1329 bolted to the horizontal members 1321 and 1322 as indicated in FIGURES 95 and 96. The lower horizontal member 1322 is bolted to webs 1331 and 1332 which are integral with and project rearwardly from the movable frame 1137. Accordingly, the sub-frame 1324 and the components thereon are moved vertically with the movable frame 1137 when height adjustments are made to adapt the machine to handle different size cartons.

The sub-frame 1324 has hubs 1334 and 1336 formed thereon which receive vertically extending pivot shafts 1337 and 1338, respectively. The shafts are each held from vertical movement with the sub-frame 1324 by arcuate fingers 1339 (FIG. 95) which are slidably received in an annular groove 1342 in the lower portions of each shaft 1337 and 1338. The fingers 1339, only those associated with pivot shaft 1337 being shown in FIGURE 95, are bolted against a ring 1343, which ring rotatably receives the end of the shaft 1337 and is bolted to the lower horizontal portion 1299 of the bracket 1292.

The cam shaft 1297 is continuously driven from a gear 1346 which is secured to the previously described turret drive sprocket 1188 and meshes with a gear 1347 (FIG. 97) keyed to the camshaft 1297. The gear ratio is such as to cause the camshaft 1297 to rotate three times during each rotation of the turret 98.

When the cartons gravitate from the lower ends of the chutes 1263 and 1264 in an upstanding position with their bottom closures lowermost, they are guided onto a deadplate 1348 (FIGS. 96 and 98) by angle guides 1349 and 1351, respectively. A film of water is directed onto the deadplate 1348 through holes 1352 and 1353 therein so as to cushion the cartons as they drop from the chutes 1263 and 1264. Carton guiding plates 1354 and 1356 are mounted on the deadplate 1348 and are secured, with the deadplate and with the angle guides, to the upper portion of the sub-frame 1324 by bolts.

As best shown in FIGURES 98, the deadplate 1348 is disposed above the carton transport conveyor chain 1201 and carriers 1246 thereon and terminates in an arcuate edge 1357 which is concentric with the axis of the turret 98. The guiding plate 1354 includes an arcuate carton guiding surface 1358 which aids in guiding cartons received from the chute 1263 into a first pickup position 1359 above the path of movement of the carriers 1246. Similarly, the guiding plate 1356 includes an arcuate guiding surface 1361 which guides the cartons received from the chute 1264 into a second pickup position 1362 above the path of movement of the carriers 1246.

As best illustrated in FIGURES 96, 98 and 99, the cartons which gravitate onto the dead plate 1348 from the chute 1263 are moved into the first pickup position 1359 and at the same time pivoted 90° about their longitudinal axes, by an upper transfer arm 1363 and a lower transfer arm 1364. The upper arm is rigidly secured to the pivot shaft 1337 and has a generally U-shaped carton engaging pocket 1366 on its free end. The lower arm 1364 (FIGS. 96 and 98) is rigidly clamped to a sleeve 1367 which is connected to the shaft 1337 for rotation therewith by an elongated key 1368 (FIG. 97) bolted to the shaft 1337. The key 1368 is slidably received in a keyway formed in the sleeve 1367 so that the lower arm 1364 will move vertically with the adjustable frame 1137 when the frame is raised or lowered to accommodate different size cartons.

Similarly, the cartons from the chute 1264 are moved into the second pick-up position 1362 while being pivoted 90° by an upper transfer arm 1369 and a lower transfer arm 1371. The upper transfer arm 1369 is rigidly secured to the pivot shaft 1338 while the lower arm 1371 is clamped on a sleeve 1372 which is connected to the shaft 1338 by a key 1373 (FIG. 97) which is slidably received in a keyway in the sleeve. Thus, the sleeve 1372 will rotate with the shaft 1338 but the sleeve 1372 will reciprocate vertically relative to the shaft. The upper

arm 1369 has a U-shaped carton engaging pocket 1374 in its free end, and the lower arm 1371 has a similarly shaped pocket 1376 on its free end.

A cam 1377 having a cam groove 1378 (FIG. 97) therein is secured to the end shaft 1297 for the purpose of actuating the pivot shafts 1337 and 1338. A lever 1379 is pivoted about a bolt 1381 which is secured to the sub-frame 1324 and has a cam follower 1382 journaled thereon and received in the cam groove 1378. A link 1383 is pivotally connected between one end of the lever 1379 and the free end of a crank arm 1384 which is rigidly secured to the sleeve 1367. The other end of the lever 1379 is pivotally connected by a link 1386a to a gear segment 1386 which is pivoted on a bolt 1387 secured to the sub-frame 1324. The gear segment 1386 is in mating engagement with a second gear segment 1388 that is rigidly secured to sleeve 1372. Thus, rotation of the cam shaft 1297 causes the transfer arms 1363, 1364 and 1369, 1371 to pivot from the phantom line position shown in FIGURE 99 to the solid line positions three times for each revolution of the turret 98.

It will be appreciated that the cartons are moved quite rapidly by the arms 1363, 1364 and 1369, 1371 into the first pickup station 1359 and the second pickup position 1362, respectively. Accordingly, a plurality of upper stop plates 1391 (FIG. 99) and lower stop plates 1392 (FIG. 98) are mounted on the crimping turret 98 for rotation therewith. The timing of the transfer arms is such that the stop plates 1391 and 1392 will terminate the movement of the cartons when they are moved into the carton pickup positions 1359 and 1362 by the transfer arms, said arms thereafter being returned to the inactive position shown in phantom in FIGURE 99.

From the foregoing it will be apparent that the two columns of cartons are transferred from the accumulator guideways 66 by the feed mechanism 96 into the pickup positions 1359 and 1362 (FIG. 99) for subsequent acceptance in a single row by the crimping turret 98 at station S15 of the filling section 54 which handles the cartons at the rate of approximately 120 cartons per minute as compared to a rate of approximately 60 cartons per minute for each of the two rows handled by the several components of the forming section 52 and the accumulating section 56. Thus, the cartons discharged from each accumulator guideway 66 will be loaded into alternate carriers 1246 of the transport conveyor chain 1201.

CRIMPING TURRET

After the cartons have been moved into the pickup positions 1359 and 1362 (FIG. 99), they are engaged by the continuously rotating crimping turret 98 at station S15 and are slid off the dead plate 1348 for acceptance by the carriers 1246 therebelow. Upon being received in the carriers, one of a plurality of crimping heads 1396 bends the top closure tabs 146 and 147 (FIG. 104) of each carton outwardly with sufficient force to tear short portions of the top closure flaps 139 and 141 at points 1397. It has been discovered that the cartons are provided with a better seal at points 1397 if the carton is slightly torn, rather than cut, in these areas. The frayed fibers resulting from a tear receive the heated polyethylene much better than do the surfaces of a clean cut, and accordingly, provides a better seal.

The crimping turret 98 (FIGS. 99 and 100) includes the aforementioned stationary column 1171 which is bolted to the stationary frame 1132, the tubular turret drive column 1179 journaled on the stationary column 1171, and the drive sprocket 1188. The drive sprocket 1188, a splash apron 1398 (FIG. 100) and the hub 1399 of the gear 1346 are bolted to a drive hub 1401 which is slidably received on the rotatable tubular column 1179. The hub 1401 is supported on the adjustable frame 1137 for movement therewith by an annular support 1402 which is bolted to the adjustable frame 1137 and has the tubular

column 1179 projecting upwardly therethrough. A pair of mating thrust bearings 1403 and 1404 are connected to a drive hub flange 1406 on the lower end of the hub 1401 and to the annular support 1402, respectively, thereby permitting rotation of the hub 1401 relative to the annular support 1402. An S-shaped bracket 1407 bolted to the support 1402 and projecting over the hub flange 1406 prevents undue separation from occurring between the thrust bearings 1403 and 1404.

A tool supporting hub 1408 is bolted to the upper end of the turret drive column 1179 and has an upwardly projecting neck 1409 rotatably received about a reduced diameter portion 1411 of the stationary column 1171. A vertically extending drive post 1412 is bolted to the drive hub 1401 and projects upwardly through a suitably bushed drive block 1413 that is rigid with the tool supporting hub 1408. It will be recognized that the drive post 1412 transmits rotary motion from the drive hub 1401 to the tool supporting hub 1408 yet permits vertical motion of the drive hub 1401 and associated parts relative to the tool supporting hub 1408.

A non-rotatable cam supporting hub 1416 is keyed to the reduced diameter portion 1411 of the stationary column 1171 and has a threaded counterbore in its upper end which receives the threaded body 1417 of a height adjustment bushing 1418. The bushing 1418 includes a small diameter bore 1419 journaled on a small diameter portion 1421 of the stationary column 1171, and a large diameter bore 1422 journaled on the portion 1411 of the shaft. A handle 1423 screwed into the bushing 1418 provides means for rotating the bushing and thereby raising or lowering the cam supporting hub 1416 to the desired elevation. The cam supporting hub 1416 is locked at the desired elevation by a threaded collar 1424 which is screwed into the small diameter portion 1421 of the stationary column 1171. A handle 1426 is screwed into the collar 1424 to provide means for readily locking the collar 1424 against the bushing 1418.

An annular cam 1427 is bolted to the cam supporting hub 1416 and includes a lower continuous annular vertical adjustment track 1428 for controlling the upward vertical movement of the crimping heads 1396, and an upper vertical adjustment arcuate track segment 1429, for assuring downward movement of the crimping heads 1396 at the appropriate time. A pickup finger cam segment 1431 is bolted to the lower end of the annular cam 1427 as illustrated in FIGURES 100 and 101.

As indicated in FIGURES 99, 100 and 101, the crimping turret 98 includes six evenly spaced identical carton pickup finger assemblies 1434 which are associated with six identical crimping head assemblies 1436. Since each assembly 1434 and 1436 are identical to the other five assemblies on the turret, only one of the carton pickup finger assemblies 1434 and one of the crimping head assemblies 1436 will be described in detail.

Each carton pickup finger assembly 1434 comprises an upper finger 1437 (FIG. 100) and a lower finger 1438. The upper finger 1437 is rigidly connected to the lower end of a vertical pivot shaft 1439 which is journaled in the tool supporting hub 1408 and has an actuating lever 1441 keyed to its upper end. The actuating lever 1441 has a cam follower 1442 journaled on its free end and arranged to ride along the camming surface 1443 of the cam segment 1431 as illustrated in FIGURE 101. The shaft 1439 is pivotally urged in a counterclockwise direction (FIG. 101) by compression springs 1444 which are disposed between a boss 1446 formed on the lever 1441 and a boss 1447 formed on the tool support hub 1408. The maximum extent of counterclockwise pivotal movement of the shaft 1439 is limited by abutment of the boss 1446 against a cap screw 1448 which is locked in adjusted position on the crimping head sub-frame 1449 by a nut 1451.

The lower finger 1438 is pivotally mounted on a cap screw 1452 (FIG. 100) which is screwed into the drive

hub 1401 and is concentric with the shaft 1439. The upper finger 1437 and lower finger 1438 are interconnected by a vertically extending rod 1453 which is rigidly secured to the lower finger 1438 and is slidably received in the upper finger 1437. Thus, the pivotal movement imparted to the upper finger 1437 by the cam segment 1431 will also be imparted to the lower finger 1438 through the rod 1453. Also, the rod may slide vertically relative to the upper finger 1437 when the frame 1137 is raised or lowered to accommodate the several sizes of cartons.

As will be apparent from FIG. 101, the cap screw 1448 associated with each pickup finger assembly 1434 is locked in a position which will maintain carton engaging surfaces of the upper finger 1437 (FIG. 99) and lower finger 1438 in a vertical plane parallel with the trailing wall of the carrier 1246 disposed therebelow. The fingers remain in this plane until they have contacted and moved the associated carton out of the pickup positions 1359 and 1362 and have moved the carton off the dead plate 1348 for acceptance by the carrier 1246 positioned therebelow.

When the cartons are being moved by the pickup fingers 1437 and 1438 off the plate 1348 (FIG. 99), arcuate guiding surfaces 1456 and 1457 of the guide plates 1354 and 1356 respectively, aid in assuring that the cartons move along the desired curved path by preventing outward movement of the cartons radially of the turret 98. The aforementioned upper stop plates 1391 and the lower stop plates 1392 prevent radial inward movement of the cartons during movement of the cartons in an arcuate path off the dead plate 1348. The upper stop plates 1391 are formed as flanges on the lower ends of brackets 1458 (FIG. 95) that are bolted to the tool supporting hub 1408. The lower stop plates 1392 are connected to an annular ring 1459 (FIG. 100) by bolts 1461 and cooperating spacers 1462. The ring 1459 is connected to the drive hub 1401 by cap screws 1452.

After moving the cartons off the end of the dead plate 1348 and into the carrier positioned therebelow, the cam segment 1431 (FIG. 101) engages the cam follower 1442 causing the fingers 1437 and 1438 to pivot rearwardly away from the carton and to remain in this position until the carton has been advanced out of the crimping turret 98 by the transport conveyor 1201.

Each crimping head assembly 1436 includes the sub-frame 1449 (FIGS. 95, 100 and 102) which is bolted to the tool supporting hubs 1408. The frame 1449 includes upper and lower hubs 1463 which slidably receive a tubular crimping head supporting shaft 1464. One of the crimping heads 1396 is rigidly secured to the tubular shaft 1464 by an elongated rod 1467 that is screwed into the crimping head 1396 and is clamped against the shaft 1464 by a nut 1468 (FIG. 102) on the upper end of the rod 1467. A split block 1469 is rigidly clamped on the shaft 1464 and has a first cam follower 1471 journaled thereon. The first cam follower 1471 is rotatably received in a vertical channel cam track 1472 defined by parallel bars 1473 and 1474 bolted to the sub-frame 1449 and positively prevents rotation of the shaft 1464 and crimping head 1396 relative to the sub-frame 1449.

In order to vertically reciprocate the crimping head 1396 in timed relation with the rotation of the turret 98, a second cam follower 1476 (FIGS. 95 and 100) is journaled on the split block 1469 and rides along the cam track 1428. It will be appreciated that the upper cam track segment 1429 also engages the cam follower 1476 in order to assure positive downward movement of the crimping head 1396 during the crimping stroke.

The crimping head 1396 (FIGS. 103, 104 and 105) comprises a body 1478 of generally rectangular shape having chamfered corners 1479 which slidably engages the inner corners of the top closure TC of the carton C. The lower portion of the body 1478 is defined by four inwardly sloping walls 1481 which aid in guiding the body 1478 into the top closure TC. Elongated slots 1482 are formed in opposite sides of the body in order to permit air

to escape from the carton as the body is inserted therein. As best shown in FIGURE 104, tab deflecting shoes 1483 and 1484 are bolted in vertical slots 1486 and 1487 formed in opposed side walls 1488 and 1489, respectively, of the body 1478. The shoes 1483 and 1484 engage the tabs 147 and 146, respectively, and deflect the tabs outwardly during downward movement of the crimping head 1396 into the carton C.

In order to sharply crimp the tabs as indicated in FIGURE 104, U-shaped gripping shoes 1491 are bolted to the side walls 1488 and 1489 of the body 1478 and have downwardly projecting fingers 1493 and 1494 disposed closely adjacent the associated tab deflecting shoes 1483 and 1484. Each finger 1493 and 1494 has its lower end formed as cams which are beveled upwardly and inwardly to guide the associated top closure flaps 141 and 142 upwardly into slots 1496 defined by relieved portions in each finger and the adjacent wall 1488 and 1489 of the body 1478. Thus, as the crimping head 1396 moves downwardly, the previously described points 1397 at the edges of the score lines separating the tabs 146 and 147 and their associated top closure flaps 139 and 141 are wedged between the inwardly sloping cams 1495 of the fingers 1493 and 1494 and the outwardly sloping surfaces of the associated tab deflecting shoes 1483. The tabs 146 and 147 are accordingly sharply crimped as indicated in FIGURE 104 and the carton material is slightly torn, rather than cut, at points 1397 so as to more readily absorb the heated polyethylene and provide a fluid-tight seal at these points.

As illustrated in FIGURES 106 and 107, each crimping head 1396 is moved downwardly into the top closure TC of the associated carton C before the carton has been advanced off the discharge end of the dead plate 1348 by the carton pickup assembly 1434. After the carton has moved off the dead plate 1348, the crimping head 1396 moves to its lowermost position thereby positively seating the carton into the carrier 1246 and simultaneously performing the crimping operation.

TOP FORMING TURRET

After the cartons have been loaded into the carriers 1246 of the continuously driven carton transport conveyor 1201 at station S14 and have been crimped by the crimping heads 1396 of the crimping turret 98 at station S15, they are advanced by the conveyor 1201 into the top forming turret 100 (FIGS. 2 and 108-114) at station S16. While in the top forming turret 100, one of a plurality of conical anvils 1501 is inserted into the top closure TC of each carton C to provide a fulcrum at the horizontal score lines 129 (FIG. 114) of the carton. A top forming head 1502 then engages the outside surfaces of the top closure flaps to bend them inwardly about the score lines 129 to the positions indicated in FIGURE 8 so as to better prepare the top closure flaps for final forming during the sealing operation.

The top forming turret 100 (FIG. 108) includes the aforementioned stationary column 1172 which is bolted to the stationary frame 1132, the tubular turret drive column 1181 which is journaled on the stationary column 1172, and the drive sprocket 1189. The drive sprocket 1189 and a splash apron 1503 are bolted to a drive hub 1504 which is slidably received on the tubular column 1181. The hub 1504 is supported on the adjustable frame 1137 for movement therewith by an annular support 1506 which is bolted to the adjustable frame 1137 and has the tubular column 1181 projecting upwardly therethrough. A pair of mating thrust bearings 1507 and 1508 are connected to a flange 1509 on the lower end of the drive hub 1504, and to the annular support 1506 thereby permitting rotation of the hub 1504 relative to the annular support 1506. An S-shaped bracket 1511 bolted to the support 1506 and projecting over the flange 1509 prevents undue separation from occurring between the thrust bearings 1507 and 1508.

A tool supporting hub **1512** is bolted to the upper end of the turret drive column **1181** and has an upwardly projecting neck **1513** rotatably received about a reduced diameter portion **1514** of the stationary column **1172**. A vertically extending drive post **1515** is bolted to the drive hub **1504** and projects upwardly through a suitably bushed drive block **1512a** that is rigidly secured to the tool supporting hub **1512**. It will be recognized that the drive post **1515** transmits rotary motion from the drive hub **1504** to the tool supporting hub **1512** yet permits vertical motion of the drive hub **1504** and associated parts relative to the tool supporting hub **1512**.

A non-rotatable cam supporting hub **1516** is keyed to the reduced diameter portion **1514** of the stationary column **1172** and has a threaded counterbore in its upper end which receives the threaded body **1517** of a height adjustment bushing **1518**. The bushing **1518** includes a small diameter bore **1519** journaled on a small diameter portion **1521** of the stationary column **1172**, and a large diameter bore **1522** journaled on the portion **1514** of the shaft. A handle **1523** screwed into the bushing **1518** provides means for rotating the bushing and thereby raising or lowering the cam supporting hub **1516** to the desired elevation. The cam supporting hub **1516** is locked at the desired elevation by a threaded collar **1524** which is screwed into the small diameter portion **1521** of the stationary column **1172**. A handle **1526** is screwed into the collar **1524** to provide means for readily locking the collar **1524** against the bushing **1518**.

An annular cam **1527** having a lower continuous annular track **1528** and an upper track segment **1529** is bolted to the cam supporting hub **1516** and causes vertical reciprocation of the conical anvils **1501** and top forming heads **1502** in timed relation with the movement of the turret **100**.

The top forming turret **100** comprises six forming head assemblies **1531** (FIGS. 108 to 111) which are equally spaced around the turret **100** and each of which includes one of the conical anvils **1501** and one of the forming heads **1502**. Since all of the assemblies **1531** are identical, only one assembly will be described in detail.

Each forming head assembly **1531** (FIGS. 108 and 109) comprises a C-shaped sub-frame **1534** which is bolted to the tool supporting hub **1512** and slidably receives a vertical extending, tubular shaft **1536** in an upper hub **1537** and a lower hub **1538**. A forming head support plate **1539** of the forming head **1502** is welded to the lower end of the shaft **1536** thereby supporting the forming head for movement with the shaft. A vertically extending anvil supporting rod **1541** is slidably received in the tubular shaft **1536** and has the conical anvil **1501** secured to its lower end. An abutment collar **1542** is clamped against the shoulder **1543** adjacent the upper end of the rod **1541** by a nut **1544** screwed on the rod. As indicated, in FIGURE 109, the abutment collar **1542** is normally supported on the upper end of the shaft **1536**. The collar **1542** is also disposed in position to engage the upper end of a stop screw **1546** which is screwed into the upper hub **1537**, and is locked in adjusted position by a lock nut **1547**.

In order to vertically reciprocate the shaft **1536** and to prevent rotation of the same relative to the C-shaped sub-frame **1534**, a split block **1548** is clamped on the tubular shaft **1536** and has cam followers **1549** (FIG. 109) and **1551** (FIG. 108) journaled thereon and disposed at 90° relative to each other. During rotation of the forming turret **100**, the cam follower **1551** rides along the upper surface of the lower cam track **1528**, and during a portion of this travel rides along the lower surface of the arcuate cam track segment **1529** thereby vertically reciprocating the shaft **1536** and parts supported thereby. The cam follower **1549** (FIG. 109) is received in a vertical cam track **1552** defined by bars **1553** and **1554** bolted to the sub-frame **1534** and holds the shaft **1536** from rotation relative to the sub-frame.

The conical anvil **1501** (FIGS. 109 to 113) comprises a lower frusto-conical lead-in portion **1556** which aids in guiding the anvil into the top closure TC of the carton C being operated upon. The lead in portion **1556** is connected at a circumferential fulcrum edge **1557** to an upper frusto-conical back up portion **1558** which is secured to the rod **1541**. As indicated in FIGURES 110 and 111, when the conical anvil **1501** is in its active position, the circumferential fulcrum edge **1557** is disposed opposite the horizontal score line **129** formed on the rectangular periphery of the carton. Since the anvil **1501** is circular in cross-section, and since the carton is square in cross-section, it will be appreciated that there will be little difficulty in inserting the anvil into the carton, and that the circumferential fulcrum edge **1557** will engage the carton only at the tangent points of the four walls.

The top forming head **1502** (FIGS. 112 and 114) comprises the aforementioned forming head support plate **1539** which is welded to the tubular shaft **1536** and has a plurality of cap screw receiving notches **1561** formed around its outer periphery. A pair of complementary flat guiding blocks **1562** and **1563** are rigidly secured to the plate **1539** by cap screws and serve to bend the flaps **142** and **143** inwardly. Each block includes a downwardly and outwardly sloping flap engaging surface **1564** having a lower flap bending portion **1566** which is directed outwardly at a sharper angle than the surface **1564** to provide a sharper bend at the carton score line **129**.

Upper recesses **1567** in the shape of vertical cylindrical segments are formed concentric with the tubular shaft **1536** in the adjacent surfaces of the blocks **1562** and **1563** and communicate with lower recesses **1568** in the surfaces **1564** and **1566**. Each recess **1568** is in the form of a segment of a cone that is concentric with the axis of the shaft **1536** and has a base of slightly larger diameter than the diameter of the fulcrum edge **1557** of the conical anvil **1501**, and has side walls that define a larger angle relative to a horizontal reference plane than do the walls of the back-up portion **1558** of the anvil **1501**. Accordingly, when the head **1502** and anvil **1501** are in the active flap forming positions illustrated in FIGURE 113, substantially equal bending forces are applied to the entire length of those score lines **129** which connect the flaps **142** and **143** to the carton walls **124** and **122**, respectively. It will be appreciated that the additional structural strength near the corners of the cartons is sufficient to resist inward deflection of the carton body during the forming operation, and that the presence of the lower recesses **1568** prevents excessive bending forces from being localized near the midpoint of the associated score lines **129**.

The blocks **1562** and **1563** also include side walls **1569** and **1571** having outwardly flaring lower end portions **1572** and **1573** which engage the flaps **141** and **139**, respectively, and guides them into active carton forming position. The inside corners **1574** (FIG. 114) defined between the walls **1569**, **1571** and the surfaces **1564** and **1566** are relieved to prevent buildup of polyethylene.

In order to bend the flaps **139** and **141** (FIG. 8) inwardly about the score lines **129** and **148** (FIGS. 8 and 109) and to bend the tabs **146** and **147** outwardly, flap forming blocks **1576** and **1577** (FIG. 112) are bolted to the head supporting plate **1539**. Each block includes a pair of spaced, downwardly projecting fingers **1578** and **1579** which have flap contacting edges **1581** and **1582** which flare outwardly and downwardly as indicated in FIGURE 112 and also flare outwardly and downwardly as indicated in FIGURE 113. A tab deflector **1583** (FIG. 112) is bolted to each block **1576** and **1577** and each deflector is angled inwardly between the spaced fingers **1578** and **1579** to engage the associated tab **146** and **147** to bend the tab downwardly as indicated in FIGURE 1.

During operation of the top forming turret **100**, the cam tracks **1528** and **1529** reciprocate the conical anvil

1501 and forming head 1502 between the positions illustrated in FIGURES 109, 110 and 111. The conical anvil 1501 is first guided into the carton by the lead-in portion 1556. The downward movement of the anvil 1501 is stopped by engagement of the stop screw 1546 with the abutment collar 1542 causing the fulcrum edge 1557 to come to rest opposite the score lines 129 of the carton as shown in FIGURE 110. The top forming head 1502 continues its downward movement causing the fingers 1578 and 1579 (FIGS. 112 and 113) to engage the flaps 139 and 141 and partially deflect them inwardly prior to engagement of the surfaces 1564 and 1566 of the blocks 1562 and 1563 with the flaps 142 and 143 respectively. Continued downward movement of the forming head 1502 causes the tab deflector 1583 to engage the tabs 146 and 147 and bend them outwardly as illustrated in FIGURE 112, thereby causing the top closure flaps to assume the positions illustrated in FIGURES 112 and 113. The forming head 1502 is then withdrawn from the carton upon upward movement of the shaft 1536 followed shortly thereafter by a withdrawal of a conical anvil 1501 from within the carton upon engagement of the collar 1542 (FIG. 110) with the upper end of the tubular shaft 1536.

It will be appreciated that the preformed top closure flaps will resist upward movement of the anvil 1501 when the anvil is being moved out of the carton. Accordingly, a plurality of leaf springs 1584, only one being shown in FIGURE 108, are secured to the drive hub 1504. Each spring 1584 is disposed opposite one of the carriers 1246 in position to close the open end thereof and to engage the bottom portion of a carton in the associated carrier 1246 to firmly clamp the carton against the wall 1249 of the carrier. Thus, upward movement of the anvil 1501 out of the carrier 1246 will not lift the carton out of the carrier. As the transport conveyor chain 1201 moves the carriers 1246, with the cartons having preformed top closures therein, away from the forming turret at station S16, it will be apparent that the springs 1584, being carried by the turret 100, will be automatically separated from the cartons and carriers.

NO-CARTON NO-FILL TURRET

After the top closure flaps of the cartons have been preformed by the top forming turret 100 (FIG. 91) at station S16, the transport conveyor chain 1201 advances the cartons supported in the carriers 1246 around the take-up sprocket 1206 and into the no-carton no-fill turret 102 at station S17. The no-carton no-fill turret 102 detects the presence or absence of a carton in each carrier 1246. If a carton is absent from a carrier 1246 a cam follower 1591 (FIGS. 115 and 116) is held in an active position in the path of movement in an actuating wheel 1592 of the particular one of the plurality of filling valves 105 of the filling turret 104 at station S18 associated with the empty carrier. If a carrier 1246 moving past the no-carton no-fill turret 104 has a carton therein, the cam follower 1591 will be held away from the path of movement of the actuating wheel 1592 of the filling valve associated with that carrier.

The no-carton no-fill turret 102 (FIG. 116) includes the aforementioned stationary column 1173 which is bolted to the stationary frame 1132 and is formed by an upper tube supporting portion 1594 which is press fitted into a lower mounting portion 1596. The tubular turret drive column 1182 is journaled on bearings 1597 and 1598 that are secured by lock nuts 1599 to a vertically movable tubular column 1601 which is bolted to the adjustable frame 1137. A lower splash apron 1602 is bolted to the sprocket 1191 and the sprocket 1191 is bolted to the rotary tubular turret drive 1182. An upper splash apron 1603 is bolted to the upper end of the tubular column 1601 thereby preventing the bearings 1597 and 1598 from becoming contaminated. A carton

back-up ring 1604 is locked to the hub of the sprocket 1191 and has resilient O-rings 1606 fitted in annular grooves in the periphery thereof and disposed in position to close the open sides of the carrier 1246 and maintain the cartons therein when the cartons are moving around the turret 102.

As shown in FIGURES 116 and 117, a rotary cam 1607 is formed on the lower end of the rotary column 1182 and has three equally spaced lobes 1608 thereon which project outwardly therefrom and are positioned to engage a cam follower 1609. The cam follower 1609 is journaled on one end of a bellcrank 1611 which is pivoted on a capscrew 1612 that is screwed into a bracket 1613 secured to the non-rotatable vertically movable column 1601 by capscrews 1614. The other end of the bellcrank 1611 has a vertically extending boss 1616 pivotally connected thereto by a capscrew 1617 and has a spring guide rod 1618 rigidly secured thereto. The other end of the rod 1618 is slidably received in a boss 1619 which is pivotally mounted on the bracket 1613 by a capscrew 1621. A helical compression spring 1622 is disposed around the rod 1618 and is fitted between the bosses 1616 and 1619 thereby urging the cam follower 1609 toward the cam 1607.

A vertically extending pivot shaft 1624 has a carton sensing finger 1625 (FIGS. 115 and 116) secured to its upper end which finger normally projects into the path of movement of cartons C carried in the carrier 1246 therepast. If a carton is absent from the carrier 1246, a locking lever 1626 that is clamped on the lower end of the shaft 1624 will be maintained in the inactive position shown in FIGURE 117 by a light tension spring 1627 connected between the lever 1626 and the bracket 1613. An abutment pin 1628 engages the lever 1626 to limit the amount of clockwise movement permitted the lever. If a carton is present in the carrier, the fingers 1625 will engage the carton shortly after the cam follower 1609 engages one of the lobes 1608.

Engagement of the cam follower 1609 with a lobe 1608 causes the bell crank 1611 to pivot in a counter-clockwise direction (FIG. 117) thereby allowing the free end of the locking lever 1626, upon engagement of the sensing finger 1625, with the carton, to be pivoted and held opposite a locking surface 1631 of the bellcrank. After the cam follower 1609 has moved off the lobe 1608, the locking surface 1631 of the bellcrank moves into abutting engagement with the free end of the locking lever 1626 thereby holding the bellcrank 1611 in an inactive position with the cam follower 1609 spaced from the cam 1607 until after the carton has moved out of engagement with the sensing finger 1625 and the next adjacent cam lobe 1608 has engaged the cam follower 1609 thereby releasing the locking lever 1626 for return to the active position shown in FIGURE 117. In this way, the no-carton no-fill turret is prepared for the next carrier, empty or filled, moving therepast.

The aforementioned cam follower 1591 (FIGS. 115 and 116) is moved between an inactive position out of the path of movement of the wheels 1592 when a carton is present in the associated carrier 1246, to an active position in the path of movement of the actuating wheels 1592 when an empty carrier passes the sensing finger 1625. In order to control the position of the cam follower 1591, one end of a connecting link 1632 (FIG. 117) is pivotally connected to the bell crank 1611 and has its other end pivotally connected to a lever 1633 secured to the upper end of a pivot shaft 1634 which is journaled in the bracket 1613 and in a hub 1636 (FIGS. 116 and 118) formed on one end of a lower bracket 1637 that is bolted to a stationary frame 1132 by bolts 1638. The shaft 1634 is of two-piece extensible construction and includes an upper section having a semi-cylindrical portion 1639 which registers with the semi-cylindrical portion 1641 of a lower section. A drive ring 1642 is welded to the lower semi-cylindrical portion 1641 and slidably

receives the upper semi-cylindrical portion 1639 thereby permitting vertical adjustment of the frame 1137 relative to the stationary frame 1132 so as to handle all four sizes of cartons upon selective adjustment of the vertically moving frame 1137.

An actuating lever 1643 (FIG. 118) is secured to a lower portion of the shaft 1634 and is pivotally connected by a link 1644 to a lever 1645 which is secured to an elongated shaft 1646 that extends through and is journaled in both the lower bracket 1637 and the tubular columns of the no-carton no-fill turret 102, and projects outwardly from the upper end of the columns. A lever 1647 is clamped to the upper end of the shaft 1646 and has the cam follower 1591 journaled on the free end thereof.

As indicated in FIGURE 91, the transport conveyor 1201 includes portions between the top forming turret 100 and the no-carton no-fill turret 102, and between the no-carton no-fill turret 102 and the top heating turret 106 which are moving closely adjacent each other in opposite directions. In order to positively prevent engagement of a tilted carton with one moving in the opposite direction relative thereto in these areas, a somewhat V-shaped carton guide 1648 (FIGS. 115 and 116) is mounted on a bracket 1649 secured to the upper tube 1594 of the stationary column 1173. The carton guide 1648 is disposed at an elevation which will engage the top closure of any carton which is improperly positioned in the associated carrier. It will be understood that improperly positioned cartons moving around the no-carton no-fill turret 102 will contact certain inside surfaces of the guide 1648, while improperly positioned cartons moving out of the top forming turret 100 or into the top heating turret 106 will contact certain outside portions of the guide 1648.

FILLING TURRET

After the continuously moving transport conveyor chain 1201 (FIGS. 115, 119A and 119B) has moved the carrier 1246 and carton supported through the no-carton no-fill turret 102 at station S17, the carriers 1246 advance the cartons into and through the filling turret 104 at station S18. While moving through the filling station S18, each carton is filled by one of the eight identical filling heads 105. If a carton C is not present in one of the carriers 1246 passing through the filling station S18, the sensing of such condition by the no-carton no-fill turret 102 at station S17 will cause the cam follower 1591 of the no-carton no-fill turret 102 to pivot the wheel 1592 through 90° thereby deactivating the particular filling head 105 associated with the empty carrier preventing discharge therefrom.

As with the other turrets of the filling section 54, the transport conveyor chain 1201 is vertically adjustable to accommodate the four sizes of cartons. In addition to the conveyor height adjustment, the filling turret 104 features an in-motion adjustment mechanism 1656 (FIGS. 119A and 119B) which may be adjusted while the machine is in motion to increase or decrease the amount of liquid entering the cartons so as to accurately comply with minimum carton weight requirements.

Another feature of the filling turret 104 is that a clean-in-place mechanism 1657 (FIG. 119B) is provided which permits cleaning liquids and flushing liquids to be run through the filling heads 105 in normal filling cycles so as to clean all internal milk passages of the filling turret 104 without requiring that the filling heads 105 be disassembled. When the clean-in-place operation is being performed, the filling turret 104 is disconnected from the drive for the other components of the filling section 54 and is operated through its normal filling cycles from a separate drive source.

The filling turret 104 (FIGS. 119A and 119B) includes the aforementioned stationary column 1174 which is

bolted to the stationary frame 1132. The tubular turret drive housing 1183 is journaled on the column 1174 by bearings 1658 and 1659 and is held from vertical movement relative to the column 1174 by lock nuts 1661 screwed on the column 1174. A drive hub 1662 is slidably mounted on the drive housing 1183 for vertical movement relative thereto. The drive sprocket 1192 is rotatably received, but normally locked in driving engagement, in an annular groove 1663 formed in the drive hub 1662 and has its lower edge closed by a splash apron 1664 bolted to the hub 1662. The hub 1662 is supported on the adjustable frame 1137 for movement therewith by an annular support 1666 which is bolted to the adjustable frame 1137 and has the tubular rotary column 1183 and stationary column 1174 projecting upwardly therethrough. A pair of mating thrust bearings 1667 and 1668 are connected to a flange 1669 on the lower end of the drive hub 1662 and to the annular support 1666, respectively, thereby permitting rotation of the drive hub 1662 relative to the annular support 1666. An S-shaped bracket 1672 bolted to the support 1666 and projecting over a flange 1669 prevents undue separation from occurring between the thrust bearings 1667 and 1668.

A guide shaft support 1674 is bolted to the rotary column 1183 and includes eight evenly spaced arms 1676 which project radially outward therefrom. The guide shaft support 1674 also includes a pair of collars 1677 (only one being shown in FIGURE 119B), each of which slidably receives a drive and cam elevating post 168 secured to the drive hub 1662. It will be noted that the drive posts 1678 transmit rotary motion from the hub 1662 yet permits vertical movement of the hub 1662 relative to the support 1674.

The lower ends of a plurality of pairs of vertically extending filling head guide shafts 1679 and 1681 are secured in bases 1682 that are bolted to the free end of the arms 1676 of the guide shaft support 1674. It will be understood that eight bases 1682 and pairs of guide shafts are provided, although only two bases and pairs of shafts are illustrated in FIGURE 119A. The upper end of each pair of guide shafts 1679 and 1681 are secured to brackets 1683 (FIG. 119A) which are bolted to a ring 1684 formed adjacent the outer periphery of a liquid supply tank 1685. The liquid supply tank 1685 includes a conical floor 1686 which has a bushing 1687 bolted to its lower surface, which bushing is journaled on the reduced diameter upper end of the stationary column 1174. Thus, it will be apparent that the pairs of guide shafts 1679 and 1681 and the tank 1685 rotate about the axis of the stationary column 1174 and is held from vertical movement relative thereto. Liquid, such as milk, is directed into the tank 1685 through a conduit 1685A which has a float controlled valve and liquid level indicator FCV at its lower end to control the flow of liquid into the tank 1685.

In order to prevent any tendency of the guide shafts 1679 and 1681 from shifting their vertical positions due to the driving forces acting thereon, a stabilizing wheel 1688 is journaled on the stationary column 1174 near the upper end thereof and has a plurality of radial arms 1689 projecting outwardly therefrom with a collar 1691 formed on the free end of each arm which slidably engages associated ones of the guide shafts 1679. The wheel 1688 includes a flange 1692 on the lower end of its hub 1693, which flange rides on the nylon thrust bushing 1694 that is supported by the flanged upper end of a track supporting hub 1696. The hub 1696 is rigidly secured to the stationary column by a pin 1697 and has a split block 1698 at its lower end. A U-shaped retainer 1699 is bolted to the hub 1696 and includes an upper portion which extends over the flange 1692 and prevents separation of the flange from the thrust bushing 1694.

A stationary upper cam 1701, diagrammatically illustrated in FIGURE 119A, is bolted to the hub 1696 and

includes an upper annular track 1702 and a lower annular track 1703. A lower annular cam 1704 of multi-piece adjustable construction is also diagrammatically illustrated in FIGURE 119A and has a stationary portion 1706 secured to the hub 1696 and an adjustable portion 1707 secured to the free end of a vertically movable cam arm 1708 (FIG. 119B) that is held from rotation by a collar 1709 integral therewith and slidably received on the stationary column 1174. As will be described in more detail hereinafter, the adjustable cam arm 1708 is supported by a non-rotatable hub 1710 that is slidably mounted on the stationary column 1174. The hub 1710 has a flange 1711 which rests on a thrust bearing 1712 that is supported by a flange 1713 of a rotatable hub 1714 which is slidably mounted on the stationary column 1174 and includes a pair of radially extending arms 1716 and 1717 bolted to the upper end of the diametrically opposed drive posts 1678, only one post being shown. Thus, upward movement of the movable frame 1137 and conveyor 1201 will be transmitted to the drive posts 1678, the hubs 1710 and 1714, and the adjustable cam track supporting arm 1708 thereby moving the adjustable portion 1707 of the cam 1708 vertically.

Since each of the eight filling valves 105 (FIGS. 122, 124) are identical, only one valve will be described in detail. Each filling valve comprises a stationary, open-ended tubular cylinder 1721 having a flange 1722 on its upper end bolted in fluid tight engagement to the ring 1684 of the tank 1685. The stationary cylinder 1721 is in constant communication with a supply of liquid in the tank 1685 through an opening 1723 in the ring 1684. The upper flanged end 1724 of movable cylinder 1726 is slidably received in the stationary cylinder 1721 and is maintained in fluid tight engagement therewith by an O-ring 1727 received in an annular groove in the flange 1724. The movable cylinder 1726 has a foot valve supporting flange 1728 intermediate of its ends, and a filling tube 1729 that is secured to and is concentric with the upper portion of the movable cylinder 1726. The arm 1731 is secured to and projects radially outward from the movable cylinder 1726 and has a cam follower 1732 journaled thereon which rides against the upper track 1705 of the adjustable cam 1704 thereby reciprocating the movable cylinder and the filling tube 1729 vertically during its movement around the cam 1704.

A foot valve 1733 at the lower end of the filling tube 1729 is secured to a U-shaped support strap 1734 having a flange 1736 rigidly secured to its upper end. The foot valve 1733 is normally held in closed position by compression springs 1737 disposed between the flange 1736 and the heads of cap screws 1738, which cap screws extend through holes in the flange 1736 and are screwed into the foot valve supporting flange 1728.

It will be noted that the foot valve 1733 may be actuated by light pressure applied to the liquid within the filling tube 1729, which pressure will overcome the resilience of the springs 1737 to automatically open the foot valve and discharge liquid from the tube. Conversely, if the pressure within the filling tube 1729 is relatively low, the springs 1737 will automatically close the foot valve preventing discharge of liquid therefrom. A pressure operated filling valve of the type mentioned above, and which may be substituted in the filling turret 104 for the piston type filler valve disclosed herein, is disclosed in United States patent application to Gordon et al. Ser. No. 429,741 which was filed Feb. 2, 1965 and is titled Liquid Dispensing Apparatus, said Gordon application issuing as Patent No. 3,295,722 on Jan. 3, 1967.

Although the foot valve 1733 may be pressure operated as above described, in the preferred embodiment illustrated in FIGURES 121 and 122, the valve is actuated by the cam track 1705a of the adjustable cam 1704 which varies in elevation relative to the upper track 1705 along a certain arcuate range thereof, to be described hereafter, so as to operate the foot valve 1733. A cam follower

1739 rides along the track 1705a and is journaled on one end of a yoke 1741 (FIGS. 121 and 122) which is pivotally connected by a pin 1742 to spaced ears 1743 projecting downwardly from the foot valve supporting flange 1728. The forked end of the yoke 1741 is pivoted on pins 1744 which are secured to and project outwardly from the flange 1736. In order to prevent rotation of the movable cylinder 1726 relative to the stationary cylinder 1721, a key 1746 (FIG. 121) is bolted to the inner surface of the stationary cylinder 1721 and rides along a keyway 1747 formed in the outer surface of the movable cylinder 1726.

As best shown in FIGURE 121, a tubular piston 1751 is disposed within the upper end of the movable cylinder 1726 and includes a lower flange 1752 which is sealed by an O-ring 1753 in its periphery to the internal surface of the movable cylinder. The upper end of the tubular piston 1751 projects upwardly into the liquid in the tank 1685 and is provided with ports 1754 to permit the liquid to enter and flow through the tubular piston.

An inlet valve 1756 is movable between positions which will open or close the lower end of the tubular piston 1751. The inlet valve 1756 is mounted on a shaft 1757 which extends upwardly through the tubular piston 1751 and has a slotted, cylindrical connector 1758 on its upper end which receives one end of an inlet valve actuating lever 1759. A similar piston actuating lever 1761 has a forked and slotted end 1762 which engages a pin 1763 extending through the upper end of the piston 1751.

The levers 1759 and 1761 project through an opening 1764 in the side wall 1766 of the tank 1685 and are pivoted on pins 1767 and 1768, respectively, which are secured to the wall 1766 of the tank. A flexible diaphragm 1769 is bonded to the pins and to the levers 1759 and 1761 and is secured to the opening 1764 by a collar 1771 and cap screws thereby sealing the opening. The outer ends of the levers 1759 and 1761 are pivotally connected to the upper ends of push rods 1773 and 1774, respectively, by links 1776 and 1777, respectively.

In order to actuate the inlet valve 1756, the lower end of the push rod 1773 is rigidly secured to a horizontal arm 1778 of an upper carrier 1779 (FIGS. 120, 124 and 125) which is slidably mounted on the associated guide shafts 1679 and 1681. A cam follower 1781 is journaled on the upper carrier 1779 and rides along the upper track 1702 of the stationary cam 1701. The lower end of the push rod 1774 is rigidly secured to a lower carrier 1782 which is slidably mounted on the guide shafts 1679 and 1681 and has a cam follower 1783 (FIGS. 123 and 125) journaled thereon which rides along a lower track 1703 of the stationary cam 1701. The lower carrier 1782 includes a horizontal, generally L-shaped arm 1784 which has a no-carton no-fill shaft 1785 journaled therein. The aforementioned no-carton no-fill actuating wheel 1592 is rigidly secured to the outer end of the shaft 1785 and includes a no-carton finger 1786 which normally projects upwardly (FIGS. 120 and 125) and a return finger 1787 which is normally horizontal and projects rearwardly. A collar 1788 is rigidly secured on the other end of the shaft 1785 and has an inlet valve opening rod 1789 welded to and projecting outwardly from the periphery thereof in a direction opposite to that of the return finger 1787. A cylinder locking finger 1791 (FIG. 125) is welded to the free end of the collar 1788 and projects outwardly therefrom in a direction opposite to that of the no-carton finger 1786.

If the no-carton no-fill turret 102 (FIG. 115) at station S17 detects a carton in the carrier 1246 associated with the filling valve 105, the cam follower 1591 will not be disposed in position to engage the finger 1786 and accordingly, the shaft 1785 will not be pivoted and the associated filling valve 105 will operate in the normal manner to fill the carton. However, if the no-carton no-fill device 102 determines that a carton is not present in the carrier 1246 associated with the filling valve 105, the cam fol-

lower 1591 will be moved in position to engage the no-carton finger 1786 of the wheel 1592 thereby pivoting the wheel and shaft 1785 through 90° in a counterclockwise direction as viewed in FIGURE 120. Such pivotal movement will move the valve opening rod 1789 to a vertical position as indicated in phantom lines in FIGURE 123 so that the upper end of the rod 1789 will move into abutting engagement under the horizontal arm 1778 of the upper carrier 1779 thereby preventing the downward motion of the upper carrier 1779 and closing the inlet valve 1756 while the empty carrier is disposed therebelow. Such pivotal movement of the shaft 1785 will also swing the cylinder locking fingers 1791 from a downward position to a horizontal position into engagement with a shoe 1793 welded on the upper end of a locking lever 1794 that is pivoted about a cap screw 1796 secured to the stationary cylinder 1721. The locking lever 1794 includes a hook 1797 on its lower end. Pivotal movement of the finger 1791 against the shoe 1793 moves the lever 1794 from the solid line position (FIG. 123) to the phantom line position thereby moving the hook 1797 into locking engagement with a pin 1798 welded to the movable cylinder 1726 holding the movable cylinder in its uppermost position with the foot valve 1733 closed until the associated empty carton carrier 1246 (FIG. 119B) has been moved out of the filling turret 104.

The wheel 1592 and shaft 1785 are returned to the inactive position shown in FIGURE 120 by engagement of the return finger 1787 with a cam follower 1799 (FIG. 119A) which is journaled on a bracket 1801 secured to a utility post 1802. The shaft 1785 is held in adjusted position by a friction washer 1803 or the like disposed between the wheel 1592 and the L-shaped arms 1784. Although the finger 1791 will slide vertically along the surface of the shoe 1793 when a carton is absent from the carrier below the valve 105, it will be understood that the friction washer 1803 will prevent the shaft 1785 from pivoting until the return finger 1787 engages the cam follower 1799.

As mentioned previously, the filling turret 104 (FIGS. 119A and 119B) selectively accommodates the four carton sizes upon vertical movement of the adjustable frame 1137 and parts, including the movable cylinder 1726, supported thereon to the proper elevation for the particular size of cartons being filled. In addition to the normal vertical movement of the parts supported by the moveable frame 1137 when adjusting the machine to handle different sizes of cartons, the previously mentioned in-motion adjustment mechanism 1656 is provided to permit small vertical adjustments of the lowermost position of the movable cylinder 1726 thereby accurately controlling the volume of liquid entering the carton being filled.

In order to provide such vertical adjustment of the movable cylinder 1726, the aforementioned cam 1704 (FIGS. 126, 127 and 128) includes the stationary portion 1706 and the adjustable portion 1707. The stationary portion 1706 which is bolted to the track supporting hub 1696 (FIG. 126) has collars 1806 and 1808 formed on opposite ends thereof. The collar 1806 registers with a collar 1809 formed integrally on the upper end of an arcuate cam segment 1811, which collar is pivotally mounted on a bolt 1812. Similarly, a collar 1813 on the upper end of an arcuate segment 1814 is pivotally mounted on a bolt 1817 which is received in the collar 1808. A lower arcuate segment 1818 of the adjustable cam portion 1707 is bolted to the arm 1708 and has collars 1819 and 1821 formed on its ends. A collar 1822 on the lower end of a segment 1823 is journaled on capscrews 1824 secured in the collar 1819, while a collar 1826 on a segment 1827 is journaled on a cap screw 1828 that is received in the collar 1821. The segment 1823 has a U-shaped groove 1829 formed therein which registers with a tongue 1831 on the segment 1811 to define a downwardly sloping portion of the cam 1704. Similarly, a U-

shaped groove 1832 (FIGS. 126 and 128) formed in the segment 1827 slidably receives a tongue 1833 of the segment 1814. Thus, it will be apparent that vertical movement of the adjustable frame 1137, and hence of the arm 1708, will cause the lower segment 1818 to move vertically and will cause the pairs of segments 1811, 1823 and 1814, 1827 to pivot about the associated bolts and to telescope relative to each other thereby defining the aforementioned annular upper track 1705 and annular lower track 1705a. Tongue and groove connections 1834 and curved end portion 1835 (FIG. 127) are provided in the lower track 1705a to permit vertical adjustment of the movable section 1707.

The in-motion adjustment mechanism 1656 (FIGS. 119A, 119B, 126, 129 and 130) comprises an air motor 1836 (FIG. 119B) which is secured to a bracket 1837 that is bolted to the stationary column 1174. A vertically extending drive shaft 1839 is coupled to the air motor 1836 and to the input shaft of a right angle gear box 1841 (FIG. 126) that is secured to the track supporting hub 1696. The output shaft of the gear box 1841 is coupled to a worm shaft 1842 which projects through openings in the stationary column 1174 and in the hub 1696 and has its free end journaled in an apertured ear 1843 bolted to the hub 1696. A worm 1844 is keyed on the output shaft 1842 and meshes with a worm gear 1846 that is connected to a splined shaft 1847 for rotation therewith and for vertical movement relative thereto. The splined shaft 1847 is journaled in ears 1848 and 1849 of the hub 1696 with the worm gear 1846 being disposed between the ears 1848 and 1849.

As best shown in FIGURE 129, the lower end of the splined shaft 1847 is reduced in diameter and has a gear 1851, and flanged bushings 1852 and 1853 secured thereto by a washer 1854 and a cap screw 1856. The bushings 1852 and 1853 are journaled in an ear 1857 projecting outwardly from the hub 1710, and the teeth 1858 of the gear 1851 mesh with mating teeth 1859 formed in the arm 1708. Thus, if it is determined that the cartons are being excessively over-filled or under-filled, the air motor 1836 may be energized to drive the splined shaft 1847 in the appropriate direction thereby causing the gear 1851 to raise or lower, depending upon the direction of rotation of the shaft 1847, the arm 1708 and the adjustable portion 1707 of the cam until the desired volume of liquid is filled into the cartons moving through the filling station S18.

In order to employ the clean-in-place mechanism 1657 to clean the internal passages of the filling turret 104, the product being packaged is removed from the tank 1685 and a cleaning solvent is pumped into the tank. The filling turret 104 is then disconnected from driving engagement with the transport conveyor 1201 and the filling turret 104 is driven through the normal filling cycle until the passages are clean. The cleaning solvent is then removed from the tank and replaced with water, and the filling turret is again placed in operation and actuated through its normal filling cycle so as to flush all traces of the solvent from the filling turret 104 with the water.

As illustrated in FIGURES 131 and 132, the filling turret sprocket 1192 is normally connected in driving engagement to the drive hub 1662 by a latch finger 1861 which is disposed between ears 1862 and 1863 of the drive hub 1662 and is pivotally supported by a pivot bolt 1864. The pivot bolt 1864 is secured to collars 1866 and 1867 which are welded to studs 1868 secured to the sprocket 1192 by nuts 1869. A pin 1871 extends through aligned holes in the latching finger 1861 and in the ears 1862 and 1863 and normally holds the latch finger 1861 in driving position. The pin 1871 is retained in the position shown in FIGURE 132 by a ball detent 1872 in the ear 1863 and cooperating groove 1873 in the pin 1871. When it is desired to disconnect the sprocket 1192 from the drive hub 1662 in order to operate the clean-in-place

mechanism 1657, the pin 1871 is merely withdrawn from the holes in the finger 1861 and ear 1862, the latch finger 1861 is pivoted downwardly about the pivot bolt 1864, and the pin 1871 is reinserted into the holes in the ears 1862 and 1863.

After the sprocket 1192 has been disconnected from the drive hub 1662 (FIG. 119B) the filling valves 105 (FIG. 119B) must first be locked in an elevated position and thereafter the drive hub 1662 and conveyor 1201 must be moved to its lowermost position so as to provide clearance between the lower end of the filling valves 105 and the carton carriers 1246. Accordingly, the movable frame 1137 is first elevated thereby lifting the hub 1710 upwardly from the position shown in FIGURE 129 to the position shown in FIGURE 130. The operator then grips the handle 1874 of a locking device 1876 and pulls it outwardly releasing a C-shaped clamp 1877 from locking engagement with the flange 1711 of the hub 1710 and the flange 1713 of the rotatable hub 1714 thereby permitting the flanges 1711 and 1713 to be separated as indicated in FIGURE 130.

The locking device 1876 includes a shouldered locking shaft 1878 which is secured to the handle 1874 by a nut 1879 and has a large diameter latching head 1881 on its free end. The shaft 1878 is slidably received in an apertured boss 1882 formed on the hub 1710 and in a bushing 1883 secured in the boss, and is urged toward the stationary column 1174 by a spring 1884. After the C-shaped clamp 1877 has released the flanges, the locking device 1876 is twisted 90° about the axis of the shaft 1878 permitting the spring to move the head 1881 into a vertical slot 1886 formed in the stationary column 1174. Thus, when the movable frame 1137 is moved to its lowermost position, the head 1881 will engage the lower end of the vertical slot 1886 preventing the filling valves from moving downwardly and providing the requisite spacing between the carriers 1246 and the lower ends of the filling valves 105.

With the filling valves 105 in their uppermost position and with the conveyor 1201 lowered to its lowermost position and disconnected from driving engagement with the filling turret 104, an auxiliary clean-in-place drive 1891 (FIGS. 119B and 135) is placed in operation. The clean-in-place drive 1891 comprises a gear motor 7M which is mounted on a bracket 1893 that is bolted to the stationary frame 1132. A double grooved drive pulley 1894 is keyed to the output shaft 1896 of the gear motor 7M and drives belts 1897 which are trained around the drive pulley 1894 and around a double grooved driven pulley 1898. The driven pulley is keyed to the lower end of a stub shaft 1899 (FIG. 135) which is journaled in a bracket 1901 secured to the frame 1132 and has a clutch drive jaw 1902 of a clutch 1903 keyed to its upper end. A driven clutch jaw 1904 having an annular groove 1904a near its upper end is mounted on the lower end of a vertical shaft 1905 for rotation therewith but for axial movement relative thereto. The shaft 1905 is journaled in a collar 1906 of the bracket 1901 and in an apertured bushing 1907 (FIG. 119B) formed on a bracket 1908 bolted to the stationary tubular column 1174. A spur gear 1909 is keyed to the upper end of the shaft 1905 and meshes with a ring gear 1912 that is rigidly secured to the tubular turret drive column 1183. Thus, when the gear motor 7M is energized and the clutch 1903 is engaged, the filling turret 104 will be driven through its normal cycle of operation.

In order to engage or disengage the clutch 1903 and to deactivate the no-carton, no-fill turret 102 (FIG. 64) at station S17, an elongated horizontally disposed clutch actuating rod 1914 (FIG. 134) is slidably received in collars 1916 that are secured to the bracket 1901 which is bolted to the stationary frame 1132. The clutch actuating rod 1914 has an operator's knob 1919 secured to one end and a no-carton no-fill deactivating finger 1921 secured to the other end thereof. The rod is held from

rotation by pins 1920 which are secured in the collars 1916 and are received in a keyway in the rod 1914. When the rod 1914 is in the clutch actuating position illustrated in FIGURE 133, the finger 1921 engages the foot 1922 formed on the previously described lever 1645 (FIGS. 118 and 133) of the no-carton no-fill turret 102 and prevents movement of the cam follower 1591 (FIG. 115) into position to engage the finger 1786 of the actuating wheel 1592 thereby permitting the filling valve heads 105 to operate through their normal cycle even though no cartons are present in the carriers 1246.

A spring 1923 is disposed between one of the collars 1916, which slidably supports the rod 1914, and a collar 1924 that is pinned to the rod thereby urging the finger 1921 away from the foot 1922. The clutch actuating rod 1914 is locked either in the active position shown in FIGURE 133, wherein the clutch 1903 is engaged, or in an inactive position by inserting a locking lug 1926 into slots 1927 and 1928, respectively, in the rod 1914. The spring 1923 urges the lug 1926 against the face of a bracket 1929 which is bolted to the stationary frame 1132.

The clutch 1903 is actuated upon reciprocation of the rod 1914 by a clutch cam 1931 which is rigidly secured to the rod 1914. The upper end of the body of the cam 1931 is slotted to receive the lower end of a push rod 1932 which has a pin 1933 extending transversely there-through and slidably engaging sloping camming surfaces 1934 of grooves formed in spaced upstanding walls of the cam 1931. The push rod 1932 is journaled in a bushing 1937 secured to the bracket 1901 and has an apertured boss 1938 formed on its upper end. A spring 1939 disposed between the bracket 1901 and boss 1938 normally urges the push rod 1932 upwardly. A yoke 1941 has one end pivotally connected to the boss and is pivoted about a shaft 1942 supported by the bracket 1901. A pair of cam followers 1944 journaled on the other end of the yoke 1941 are slidably received in the groove 1904a of the driven clutch jaw 1904 thereby permitting rotation of the clutch jaw 1904 relative to the yoke 1941 and permitting the yoke to move the jaw 1904 vertically between the engaged and disengaged position in response to reciprocation of the rod 1914.

Thus, when the rod 1914 is moved to the position shown in solid lines FIGURE 133 and is locked therein by the lug 1926, the finger 1921 engages the foot 1645 deactivating the no-carton no-fill turret 102 and the cam actuated yoke 1941 engages the clutch 1903 thereby driving the filling turret 104 through the auxiliary clean-in-place drive 1891 causing the filling heads 105 to operate in the normal manner. It will, of course, be realized that during the clean-in-place operation, cartons will not be present around the filling turret and that the cleaning solvent or flush water may be collected after flowing through the valves in troughs (not shown) and may be returned to the tank 1685 for recycling.

In order to better understand the operation of each filling head 105, reference may be had to FIGURES 136 through 144 which illustrate progressive positions of the different components of the filling head as controlled by the cam tracks 1702, 1703, 1705 and 1705a illustrated in the cam diagram shown in FIGURE 145. When the filling head 105 is at its starting position which is indicated as the 0° position in FIGURES 115 and 145, the parts of the filling head are positioned as indicated in FIGURE 136. At this time, the inlet valve 1756 is open, the piston 1751 and movable cylinder 1726 are in their uppermost positions, and the foot valve 1733 closes the lower end of the filling tube 1729. During the next 70° of rotation of the filling turret, the movable cylinder 1726 moves downwardly to its lowermost position as indicated in FIG. 137 with the foot valve 1733 closed and spaced above the carton bottom closure approximately $\frac{7}{16}$ of an inch. During this motion the piston 1751 remains in its uppermost position and the inlet valve 1756 is open there-

by permitting a column of liquid to flow from the tank 1685 into the movable cylinder 1726 and its associated filling tube thereby completely filling the same. The inlet valve 1756 is then closed as indicated in FIG. 138 by the cam track 1702, and shortly thereafter the foot valve 1733 is opened by the cam track 1705a as indicated in FIG. 139.

With the inlet valve 1756 closed and the foot valve 1733 opened, the piston 1751 and closed inlet valve are slowly moved downwardly as a unit thereby slowly forcing liquid into the carton C covering the lower end of the filling tube 1729 and foot valve 1733 with liquid thus preventing foaming. As indicated in the cam diagram of FIG. 145, this preliminary filling occurs between approximately 85° and 175° range of rotation of the filling turret 104. It will also be understood that although the cam track 1705a is provided for opening the foot valve 1733 in the preferred embodiment of the filling valve, the cam 1705a could be omitted and the foot valve could be opened by pressure exerted thereagainst by liquid resulting from the downward movement of the piston and, subsequently the upward movement of the movable cylinder 1726.

After the preliminary filling step has been completed upon rotation of the filling turret 104 through the first 175° of its cycle of operation thereby covering the lower end of the filling tube 1729 with liquid, the movable cylinder 1726 and the open foot valve 1733 (FIG. 141) are more rapidly moved upwardly as a unit by the cam tracks 1705 and 1705a. This main filling operation occurs during the 175° to 215° range of travel of the filling turret 105, and upon completion of the main filling cycle the foot valve 1733 is closed as indicated in FIG. 142 with the lower end of the filling tube 1729 covered by approximately 3/8 of an inch of liquid. The inlet valve 1756 is then opened as indicated in FIG. 143 while the movable cylinder 1726 and foot valve 1733 move through a 10° safety period at which time they remain at a constant elevation. With the inlet valve 1756 open and with the foot valve 1733 closed, the foot valve and filling tube 1729 are moved upwardly out of the carton to the starting position, and simultaneously therewith, the inlet valve 1756 and piston 1751 move to their starting positions as indicated in FIG. 144, thereby completing one cycle of operations of one of the filling heads 105.

The filled carton is then discharged from the filling turret 104 at station S18 and is conveyed into the top heating turret 106, at station S19 by the continuously driven carton transport conveyor chain 1201 of transport conveyor 68 (FIG. 1).

TOP HEATING TURRET

After the cartons C have been filled at station S18 (FIG. 2) they are advanced into the top heating station S19 by the conveyor 68. The top heating turret 106 (FIGS. 146-155) includes a plurality of identical top heating heads 1951 that are arranged to direct hot air only at those surfaces of the top closures TC which are subsequently sealed together.

The top heating turret 106 (FIG. 146) includes the aforementioned stationary column 1175 which is bolted to the stationary frame 1132, the tubular turret drive column 1184 which is journaled on the stationary column 1175, and the drive sprocket 1193. The drive sprocket 1193 and the splash apron 1952 are bolted to a drive hub 1953 which is slidably received on the tubular drive column 1184. The hub 1953 is supported on the adjustable frame 1137 for movement therewith by an annular support 1956 which is bolted to the adjustable frame 1137 and has the rotary column 1184 and stationary column 1175 projecting upwardly therethrough. A pair of mating thrust bearings 1957 and 1958 are respectively connected to a flange 1959 on the lower end of the drive hub 1953 and to the annular support 1956 thereby permitting rotation of the

hub 1953 relative to the annular support 1956. A Z-shaped bracket 1961 bolted to the support 1956 and projecting over the flange 1959 prevents undue separation from occurring between the thrust bearings 1957 and 1958.

A tool supporting hub 1962 is bolted to the upper end of the turret drive column 1184 and has an upwardly projecting neck 1963 disposed around a reduced diameter portion 1964 of the stationary column 1175. A vertically extending drive post 1965 is bolted to the drive hub 1953 and projects upwardly through a suitable drive block 1966 that is rigidly secured to the tool supporting hub 1962. It will be recognized that the drive post 1965 transmits rotary motion from the drive hub 1953 to the tool supporting hub 1962 yet permits vertical motion of the drive hub 1953 and associated parts relative to the tool supporting hub 1962.

A non-rotatable cam supporting hub 1968 is keyed to the reduced diameter portion 1964 of the stationary column 1175. An annular cam 1969 having an annular cam groove 1971 therein is bolted to the cam supporting hub 1968 and causes vertical reciprocation of the top heating heads 1951 during rotation of the turret 106.

In order to direct low pressure, hot air at approximately 800° F. to the top heating heads 1951, the top heating turret 106 includes an air heating and controlling mechanism 1976 (FIGS. 146-151) which receives cool, sterile air from a blower system soon to be described. A volume of low pressure sterile air in excess of that required by the top heating heads 1951 is directed from a conduit 1977 (FIG. 147) into an elbow 1978 past a butterfly valve 1979. The butterfly valve 1979 is adjusted and locked in adjusted position to assure that a desired amount of air from the low pressure blower system enters the mechanism 1976. The air then flows into a distribution manifold 1981 having a plurality of radial passages 1982 therein. Each passage 1982 communicates with a tubular heating housing 1983 and with a discharge port 1984. Each discharge port 1984 is partially closed by a conical valve 1986 that is supported by an adjustable bolt 1987 screwed into an upstanding flange 1988 of the distribution manifold 1981. Each conical valve 1986 is spaced a desired amount from the associated discharge port 1984 and is locked in adjusted position by a lock nut 1989 so as to permit a certain portion of the air entering the distribution manifold 1981 to be discharged past the valve 1986 to the atmosphere. Accordingly, the volume of air flowing downwardly within each tubular heating housing 1983 and past a heating coil 1991 therein, may be controlled with the result that the temperature at the heating heads 1951 may be maintained at approximately 800° F. Each heating coil 1991 (only one being shown in FIG. 146) is connected by a conductor 1992 to junction box 1993 located at the upper end of the heating and controlling mechanism 1976 and connected to a suitable source of electrical power.

The lower end of each heating housing 1983 is secured in air-tight relation to an associated sleeve 1994 formed integrally with the upper wall 1996 of an upper distribution housing 1997 which defines an annular hot air chamber 1998 therein. A thermocouple 2000 is inserted in the chamber 1998 to sense the temperature of the air. The upper housing 1997 includes a central hub 1999 having a cap 2001 bolted to its upper end. A small diameter portion 2003 of the stationary column 1175 projects into the hub 1999 and into the cap 2001 and is provided with a mounting shoulder 2004 defined by an intermediate diameter portion 2005 of the stationary column 1175. A lower distribution housing 2006 is disposed around the intermediate portion 2005 and communicates with the upper housing 1997 through passages soon to be described and distributes the hot air evenly to each of the top heating heads at station S19.

The lower housing 2006 is circular in shape and has a plurality of evenly spaced openings 2007 formed in its lower wall adjacent the periphery thereof. Each opening slidably receives the upper end of a tube 2008 which sup-

ports an associated one of the heating heads 1951 and directs the hot air from the lower housing 2006 into the heating head. The tubes 2008 are each slidably received in a suction head supporting frame 2009 (FIGS. 146 and 152) and each frame has its lower end bolted to the tool supporting hub 1962 and its upper end bolted to the lower housing 2006 as clearly indicated in FIGURE 146. Thus, it will be apparent that the lower distribution housing 2006 rotates with the top heating heads 1951.

In order to prevent scorching of the top closures of the cartons positioned at the top heating station S19 during temporary stops of the top forming turret 106, and yet prevent cooling of the heating heads 1951 and the flow passages to the heads, a rotary control valve 2016 is provided between the upper distribution housing 1997 and the lower distribution housing 2006. The rotary control valve 2016 (FIGS. 146 and 148-151) comprises a centrally apertured disc 2017 which is pivotally mounted between an annular lip projecting downwardly from a bottom wall 2019 of the upper distribution housing 2006 and rests on a nylon disc 2021 secured to the upper wall of the upper housing 2006. A compression spring 2022 is positioned around the reduced diameter portion 2003 of the tubular column 1175 and bears against the cap 2001 and a washer 2023 supporting on the shoulder 2004 formed between the portions 2003 and 2005 of the tubular column 1175. The spring 2022 serves to support a portion of the weight of the upper housing 2006 and parts carried thereby.

As best shown in FIGURE 148, a pneumatic cylinder 2026 is pivotally supported by the previously mentioned utility post 1802 and has its piston rod 2028 pivotally connected to an arm 2029 projecting outwardly from the disc 2017. The pneumatic cylinder 2026 holds the disc 2017 in the position illustrated in FIGURE 149 during normal operation, and shifts the disc 2017 to the position shown in FIGURE 150 only when the turret 106 is momentarily stopped. When the disc 2017 is held in its normal operating position as indicated in FIGURE 149, short arcuate slots 2031 in the disc near its outer periphery are held out of registration with corresponding slots 2032 in the bottom wall 2019 of the upper housing 2006, and accordingly, prevents air from flowing therepast. At this time, all the air entering the upper distribution housing 1997 flows into the lower housing 2006 through a plurality of circular holes 2036 in the floor 2019 of the upper housing 1997, through a plurality of circular holes 2037 in the disc 2017, and through a plurality of arcuate slots 2038 in the nylon disc 2021 and in the upper wall of the lower housing 2006. When positioned as above mentioned, the holes 2036, 2037, and the slots 2038 provide unrestricted flow passages from the upper housing 1997 to the lower housing 2006.

If the top heating turret 106 is momentarily stopped with cartons disposed in alignment with the top heating heads 1951 at station S19, the pneumatic cylinder 2026 is activated by means which will be described hereinafter, thereby shifting the disc 2017 to the position shown in FIGURES 150 and 151. Shifting of the disc 2017 causes the slots 2031 and 2032 to register thereby diverting the major portion of the hot air to the outer atmosphere away from the top heating heads 1951. However, the holes 2037 in the disc 2017 remain in partial registration with the holes 2036 and slots 2038 thereby permitting sufficient hot air to flow through the top heating heads 1951 to prevent cooling of the heads and to maintain the heads and passages connected thereto at the desired operation temperature. It will be understood, however, that insufficient hot air will be directed against the cartons to scorch or otherwise injure the cartons. Thus, all cartons which are carried out of station S19 will be heated to the desired sealing temperature.

As mentioned previously, the top heating heads 1951 (FIG. 152) are each mounted on the lower end of the tubes 2008 and the tubes are slidably received for vertical

movement in the heating head supporting frame 2009. Each tube 2008 (FIG. 152) has a split block 2039 clamped thereon, which split block rotatably supports cam followers 2041 and 2042 journaled thereon and disposed at 90° relative to each other. The cam follower 2041 rides in a vertical slot 2043 formed in the frame 2009 and prevents rotation of the tube 2008 relative to the frame. Each cam follower 2042 (FIG. 146) rides in the cam groove 1971 of the cam 1969 thereby reciprocating each top heating head 1951 between a position spaced above the associated carton as indicated in FIGURE 155 to an operative position in engagement with the top closure as indicated in FIGURES 153 and 154 during movement of each carton through the top heating station S19 by the conveyor chain 1201.

Each top heating head 1951 (FIGS. 153 and 155) comprises an apertured mounting plate 2046 that is welded to the lower end of the associated tube 2008. A generally rectangular housing 2047 having an open upper end clamped in air tight engagement to the plate 2046 defines a plenum chamber 2048 that is in communication with the hot air in the tube 2008. The housing 2047 has a lower floor 2049 which is ported to direct hot air into a downwardly projecting inner air distribution housing 2051. The inner housing 2051 directs hot air against those internal surfaces of the top closure TC which are subsequently sealed to other surfaces of the top closure. The inner housing 2051 includes a generally X-shaped vertical wall 2053 which has a closed lower wall 2054 formed integrally with the X-shaped wall 2053 and has an open upper end that is clamped against the floor 2049 by cap screws 2056. As indicated in FIGURES 153, 154 and 155 perforations 2057 are provided in those portions of the X-shaped wall 2053 which are adjacent the inside surfaces of the top closure TC which are subsequently sealed together.

In order to direct hot air against the upper outside portion of the top closure lip 152 of the carton C, an end distribution housing 2058 of U-shaped configuration is clamped against the floor 2049 of the plenum chamber 2048 and communicates therewith through a port 2059 in the floor 2049. Hot air is directed against the wall 152 of the carton from the end distribution housing 2058 through perforations 2061 in the inner housing wall.

A pair of complementary side distribution housings 2062 and 2063 (FIG. 155) are provided for directing hot air at the tabs 146, 147 at the shallow ears 149, and at the long ears 151 of the flaps 139 and 141, respectively. The housings 2062 and 2063 each have an open upper end bolted to the floor 2049 of the plenum chamber 2048 and communicates therewith through openings 2064 (FIG. 153). Each housing 2062 and 2063 includes a generally V-shaped inner perforated wall 2066 which directs hot air at the associated ears 149 and 151 of the cartons top closure TC. Each side housing 2062 and 2063 also includes a recessed horizontal wall 2067 that is perforated so as to direct hot air at the tabs 146 and 147. The tabs 146 and 147 are held in spaced relation from the face of the wall 2067 by spacers 2068 welded to the walls 2067.

In order to guide the pre-formed top closure TC of a carton into the associated top heating head, a guide plate 2069 is bolted to angle brackets 2071 secured to the housing 2047 and has a generally rectangular opening 2072 formed therein. Upstanding inwardly converging angle guides 2073 are formed on each corner of the opening and engage corresponding corners of the carton to guide the carton into the top heating head 1951. Certain surfaces of the top heating head are beveled to aid in guiding the carton into operative heating positions in the head. It will be understood that hot air is directed at the sealing surfaces of the top closure while the carton is passing through the top heating station S19 for an interval which is sufficient to raise the temperature of the polyethylene coating to a desired bonding temperature.

As mentioned previously, the blower system is provided to direct sterile air into the bottom heater heads 82 (FIGS. 1 and 2) of the bottom heater 84 at stations 86 and S7 and into the top heater heads 1951 (FIG. 146) of the top heating turret 106 at station S19. The blower system 2076 (FIG. 91) is supported by the stationary frame 1132 and comprises a low pressure centrifugal blower 2077 that is driven by a motor 5M. A large capacity filter 2079 is connected to the suction manifold 2081 of the blower 2077 thereby assuring that sterile air will be discharged from the blower's discharge manifold 2082 at approximately 6 inches of static pressure. The discharge manifold 2082 is connected by conduits 2083 which direct the sterile air to the utility posts 727 and 1802 which are connected to and direct air into the bottom heater 84 and top heating turret 106, respectively.

TOP SEALING TURRET

After the surfaces of the top closure TC of each carton C that are to be sealed to other surfaces of the top closure have been heated to a bonding temperature by the top heating turret 106 at station S19, the carton transport conveyor chain 1201 moves the cartons into the top sealing turret 108 (FIGS. 156 to 178) at the top sealing Station S20. While moving through station S20, the upper end of each carton is squared, and the top closure is sealed by one of eight identical top sealing heads 2096.

The top sealing turret 108 (FIG. 156) includes the aforementioned stationary column 1176 which is bolted to the stationary frame 1132, the tubular drive column 1186 which is journaled on the stationary column 1176, and the drive sprocket 1194. The drive sprocket 1194, a splash apron 2098, and the sprocket 1237 are bolted to a drive hub 2101 which is slidably received on the tubular drive column 1186. The hub 2101 is supported on the adjustable frame 1137 for movement therewith by an annular support 2102 which is bolted to the adjustable frame 1137 and has the tubular columns 1176 and 1186 projecting upwardly therethrough. A pair of mating thrust bearings 2103 and 2104 are connected to a flange 2106 on the lower end of the hub 2101 and to the annular support 2102, respectively, thereby permitting rotation of the hub 2101 relative to the annular support 2102. A tool supporting hub 2108 is bolted to the upper end of the turret drive column 1186 and has an upwardly projecting neck 2109 rotatably received around a reduced diameter portion 2111 of the stationary column 1176. A vertically extending drive post 2112 is bolted to the drive hub 2101 and projects upwardly through a drive block 2113 that is rigid with the tool supporting hub 2108. It will be recognized that the drive post 2112 transmits rotary motion from the drive hub 2101 to the tool supporting hub 2108 yet permits vertical movement of the drive hub 2101 and associated parts relative to the tool supporting hub 2108.

A non-rotatable cam supporting hub 2116 is keyed to the reduced diameter portion 2111 of the stationary column 1176 and has a threaded counterbore in its upper end which receives the threaded body 2117 of a height adjustment bushing 2118. The bushing 2118 includes a small diameter bore 2119 journaled on a small diameter portion 2121 of the stationary column 1176, and a large diameter bore 2122 journaled on the portion 2111 of the column 1176. A handle 2123 screwed into the bushing 118 provides means for rotating the bushing and thereby raising or lowering the cam supporting hub 2116 to the desired elevation. The cam supporting hub 2116 is locked at the desired elevation by a lock nut 2124 which is screwed onto the small diameter portion 2121 of the stationary column 1176. A handle 2126 is screwed into the locknut 2124 to provide means for readily locking the bushing 2118 at the desired elevation.

A cam 2127 is bolted to the stationary cam supporting hub 2116 and has a pair of cam tracks 2128 and 2129

formed therein. The cam track 2128 is concentric with the axis of the top sealing turret 108 and serves to vertically reciprocate the eight identical top sealing heads 2096 in timed relation with the movement of the turret. The cam track 2129 follows the vertical undulations of the track 2128 but deviates from a path that is concentric with the track 2128 so as to impart the necessary movement to each top sealing head which effects the closing and sealing of the top closure TC of the associated cartons C.

The top sealing heads 2096 are equally spaced around the turret 108 and are slidably supported by the tool supporting hub 2108. The tool supporting hub 2108 (FIGS. 156-159) has a plurality of equally spaced flanges 2133 projecting radially outwardly therefrom with a vertical carrier rod 2134 secured to the outer end of each flange 2133.

Since each of the eight top sealing heads 2096 are identical, the description and operation of only one of the heads will be described in detail.

In general, each top sealing head 2096 (FIGS. 157 and 160) includes a pair of pressure resisting anvils 2136 and 2137 which are inserted below the tabs 146 and 147 (FIG. 169) of the top closure TC and resist downward movement thereof during the sealing operation. Each head also includes a folding shoe 2138 (FIG. 168) which folds the narrow lip 152 of the top closure downwardly, a rear flap support 2139 which holds the flap 143 in sealing position, and a sealing shoe 2141 which folds the wide lip 153 over the narrow lip 152 and then applies the necessary sealing pressure to the top closure against the resistance of the anvil to seal the top closure.

Each top sealing head 2096 comprises a carrier 2146 (FIGS. 156 to 160) having a cam follower 2147 journaled on its upper end and received in the cam track 2128. The carrier 2146 comprises a generally annular shaped body 2148 (FIG. 158) having a pair of widely spaced collars 2149 and 2151 formed integrally with one vertical side wall 2153 thereof and slidably received on one of the carrier guide rods 2134. A single collar 2154 is formed on the other vertical side wall 2156 and is slidably received on the next adjacent guide rod 2134 at an elevation intermediate the collars 2149 and 2151. Thus, each carrier guide rod 2134 slidably receives the two collars 2149 and 2151 of one of the carriers, and the single collar 2154 of the next adjacent carrier to slidably control the vertical reciprocation of the carriers 2146 imparted thereto by the cam track 2128.

In order to partially compensate for the weight of each top sealing head 2096, a tension spring 2157 is connected between a cap screw 2158 screwed into the upper end of the associated flange 2133 and a cap screw 2159 (FIG. 160) screwed into the lower end of the carrier 2146.

As mentioned previously, the cam track 2129 is provided for actuating the anvils 2136 and 2137, the folding shoe 2138, the flap support 2139 and the sealing shoe 2144 in timed relation with the movement of the turret 108. For causing the anvils, flap support, folding shoe and sealing shoe to operate in timed relation with each other, a multiple faced cam 2161 (FIG. 162) is journaled on a shaft 2162 that is secured to the carrier 2146 as best indicated in FIGURE 158. The multiple faced cam 2161 has a cam follower 2163 journaled on its upper end and received in the turret cam track 2129 which swings the follower through an arcuate range of approximately 80° as indicated in FIGURE 163.

The multiple faced cam 2161 comprises a generally tubular body 2164 to which a plurality of cam tracks are bolted. The anvils 2136 and 2137 are controlled by anvil cam tracks 2166 and 2167 (FIGS. 162-164), respectively, that are bolted to the lower portion of the body 2164 and cause the anvils to move between the position shown in FIGURE 164 and the position shown in FIGURE 160. A sealing shoe cam track 2168 is bolted to the body 2164 and controls the actuation of the sealing shoe

2141, while a similar cam track 2169 that is bolted to the body 2164 controls the actuation of the rear flap support 2139. A pressure applying cam track 2171 is bolted near the upper end of the body 2164 and applies the necessary pressure to the top closure of the carton to seal the same.

As best shown in FIGURES 164 and 165, the anvils 2136 and 2137 are rigidly secured to the lower ends of the arms 2172 and 2173, respectively. The arms 2172 and 2173 are apertured near their upper ends to receive bosses 2174 and 2176 that are integrally formed on the lower end of the carrier 2146. The arms 2172 and 2173 are pivotally mounted on the bosses by pivot bolts 2177. Cam followers 2178 and 2179 journaled on the upper end of the arm 2172 and 2173, respectively, are received in the cam tracks 2166 and 2167, respectively, and upon rotation of the multiple faced cam 2161 move the anvils between the positions shown in solid lines in FIGURE 164 and the position shown in phantom lines.

As the anvils are being moved into active position into engagement with the top closure flap, the carton is engaged by carton guides 2181 (FIG. 165) bolted to the arms 2172 and 2173 which guides accurately square the carton. Stop plates 2182 are rigidly secured to the guides 2181 and serve to accurately center the carton. In addition to the guides 2181 and the stop plates 2182, the top closure tabs 146 and 147 and the edges of the lips 152 and 153 (FIG. 175) are centered and squared by a pair of pins 2183 secured to and projecting upwardly from each anvil 2136 and 2137. The carton contacting surface of the anvil 2137 is recessed at 2184 to accommodate the extra thickness resulting from the presence of the carton flange 125 (FIG. 11).

The rear flap support 2139 is provided in order to fold the rear carton flap 143 (FIG. 168) into sealing position. The rear flap support 2139 (FIG. 166) comprises a pair of spaced upstanding arms 2192 and 2193 which are pivotally supported on a shaft 2194 that has a rectangular central section 2196 and is pivotally supported in the bosses 2174 and 2176 of the carrier 2146. The arms 2192 and 2193 are formed integrally with a body 2197 having a flat flap contacting surface 2198 at its lower end. An ear 2199 formed on the body 2197 has a pivot bolt 2201 screwed therein which pivotally receives one end of the actuating link 2202. The other end of the actuating link 2202 is pivotally connected by a bolt 2203 (FIG. 157) to one end of a lever 2204 having its other end pivotally supported on a cap screw 2206 screwed into the carrier 2146. A cam follower 2207 is journaled on the lever 2204 intermediate its ends and is slidably received in the cam track 2169. Thus, pivotal movement of the multiple faced cam 2161 will cause the rear flap support to pivot between a position spaced from the carton and the position engaging the carton flap 143 and holding the flap in sealed position.

The body 2197 of the flap support 2139 includes an ear 2208 (FIG. 166) which has a stop bolt 2209 locked therein. A centrally disposed yoke 2211 is formed on the body 2197 and has a pin 2212 secured thereto, which pin supports the lower ends of a pair of springs 2213. The stop bolts 2209 and springs 2213 cooperate with the folding shoe 2138 (FIGS. 167 and 168) as will be made apparent hereinafter.

The folding shoe 2138 is provided to engage and bend the narrow lip 152 downwardly below the wide lip 153 of the carton. The folding shoe 2138 comprises a shoe supporting yoke 2214 having a pair of spaced arms 2215 and 2216 pivotally mounted on the shaft 2194. A tongue 2217 projects rearwardly from the yoke 2214 and has a pin 2218 secured thereto which supports the other end of the springs 2213. The springs 2213 urge the yoke 2214 to pivot in a counterclockwise direction, which pivotal movement is normally limited by the stop bolt 2209 which engages a resilient pad bonded to a cap screw 2220 that is screwed in the tongue 2217. Counterclockwise pivotal movement of the rear flap support 2139 will cause the

folding shoe 2138 to pivot therewith until the pivotal movement is limited by an L-shaped stop arm 2219 (shown in phantom line in FIGURE 167) that is secured to the arm 2215. A cap screw 2221 (FIGS. 157 and 168) with a resilient pad fitted therein is bolted to the stop arm 2219. The pad is disposed in position to be engaged by a stop bolt 2223 and immediately before the sealing shoe 2144 is moved into the top sealing position. The stop bolt 2223 is secured to the free end of the sealing shoe actuating the lever 2224 which lever is keyed to the shaft 2194.

As indicated in FIGURE 167, the yoke 2214 includes a pair of spaced downwardly projecting arms 2226 and 2227 which are interconnected by a tongue 2228 that is apertured to receive a pivot shaft 2229. A folding shoe foot 2231 includes a curved carton engaging surface 2232 and a pair of spaced collars 2233 and 2234 which are journaled on the pivot shaft 2229. A cam follower arm 2236 is formed integrally with the collar 2233 and has a cam follower 2237 journaled on its free end. A T-shaped overcenter lockplate 2238 is formed integrally with the collar 2234 and has a pin 2239 projecting outwardly therefrom to which one end of an overcenter lock spring 2241 is attached. The other end of the spring 2241 is connected to a pin 2242 secured to the arm 2227 of the yoke 2214. Abutment surfaces 2243 and 2244 (FIG. 170) on the lower end of the arm 2227 alternately engage the upper surface of the T-shaped overcenter lock plate 2238 to limit the pivotal movement of the foot 2231 in a clockwise and counterclockwise direction, respectively. The folding shoe foot 2231 is pivoted in a clockwise direction upon engagement of the cam follower 2237 with a lower hook shaped cam track 2246 (FIGS. 158 and 176) and is pivoted in a counterclockwise direction by an upper cam track 2247. The cam tracks 2246 and 2247 are bolted to a bracket 2248 which is bolted to the lower end of the carrier 2146.

The sealing shoe 2141 (FIGS. 160 and 168) comprises a body 2251 which has a pressure applying plate 2252 bolted to its lower end. The pressure applying plate includes a sealing surface 2253 and a flap bending surface 2254 which is inclined relative to the sealing surface. An elongated slot 2256 in the upper end of the body 2251 slidably receives the rectangular section 2196 of the shaft 2194 thereby permitting sliding movement of the sealing shoe 2141 relative to the shaft 2194. A roller 2257 is journaled on a bolt 2258 secured to the rectangular section 2196 on the shaft and rides in a vertical slot 2259 (FIG. 160) formed in the forward wall of the body 2251. A similar slot 2260 is formed in the rear wall of the body 2251 to receive the end of the bolt 2258. A cap 2261 is bolted to the upper end of the body 2251 to retain the rectangular section 2196 of the shaft 2194 in the slot 2256. A pair of compression springs 2262 (only one being shown in FIG. 168) are disposed between the cap 2261 and the rectangular shaft section 2194 and normally urges the body 2251 upwardly.

The sealing shoe 2141 is pivoted between the inactive position shown in FIGURE 168 and the active position shown in FIGURE 176 by the cam track 2168 (FIG. 157) upon pivotal movement of the multiple faced cam 2161. A cam follower 2263 is journaled on an actuating lever 2264 intermediate its ends, which actuating lever 2264 has one end pivoted on a cap screw 2266 secured to the carrier 2146. The other end of the lever 2264 is pivotally connected by a pivot bolt 2267 to one end of a link 2268. The other end of the link 2268 is pivotally connected by a pivot bolt 2271 to an intermediate portion of the sealing shoe actuating lever 2224 thereby completing the necessary drive to pivot the sealing shoe 2141 between the two operative positions mentioned above.

After the sealing shoe 2141, the folding shoe 2138 and the rear flap support 2139 have been pivoted to the position shown in FIGURE 176 thereby folding the top

closure of the carton into sealing position, and after the anvils 2136 and 2137 have been moved into the position shown in FIGURE 177, sealing pressure is supplied by the sealing shoe 2141 to the top closure of the carton. In order to apply the requisite sealing pressure to the sealing shoe 2141, a bell crank 2273 (FIG. 160) is pivoted on a bolt 2274 secured to the carrier 2146. One end of the bell crank 2273 has a cam follower 2276 journaled thereon which rides in the cam track 2171. The other end of the bell crank 2273 is pivotally connected to a link 2277 that is screwed into the head 2278 of the bolt 2279 (FIG. 161). The bolt 2279 is slidably received in a crossbar 2280 which is urged against the bolt head 2278 by a compression spring 2281 disposed between the crossbar 2280 and a bushing 2282 held in place on the bolt 2279 by lock nuts 2283. The crossbar 2280 is pivotally received in the forked upper end of a bell crank 2284 that is pivoted on a bolt 2286 (FIG. 160) secured to the carrier 2146. The other end of the bell crank 2284 has a roller 2287 journaled thereon which engages the upper surface of the cap 2261 of the sealing shoe 2141 thereby urging the shoe downwardly into sealing engagement with the top closure of the carton upon rotation of the multiple faced cam 2161 in a counterclockwise direction as viewed in FIGURE 161.

In order to dissipate heat imparted to the sealing shoe 2141 and anvils 2136 and 2137 by the hot top closure flaps, cooling water is circulated through the shoe 2141 and anvils 2136 and 2137. Cooling water is introduced into the top sealing turret 108 through an inlet port 2288 (FIG. 156) which directs the water through a tube 2289 inserted in an elongated passage 2291 in the upper end of the previously described stationary column 1176. The lower end of the tube 2289 is sealed to the wall of the passage 2291 by a sleeve 2292 (FIG. 160) and directs the cooling water into a lower transverse inlet passage 2293 in the stationary column 1176. An upper transverse outlet passage 2294 in the column 1176 receives spent cooling water and directs it upwardly through the elongated passage 2291 for discharge from the sealing turret 108 from a discharge port 2296 (FIG. 156).

As best shown in FIGURE 160, a mechanical seal 2297 is fitted in a counterbore 2298 in the upper end of the rotary column 1186 and serves to permit rotation to occur between the stationary and rotary columns and to isolate the inlet cooling water from the spent cooling water. Each top sealing head 2096 is provided with a conduit system 2299 which includes a flexible tube 2301 having one end secured to the rotary column 1186 and communicating with the transverse inlet passage 2293, and having its other end connected to a port 2302 in the upper end of the carrier 2146. One end of another flexible tube 2303 is connected to the port 2302 and has its other end communicating with a cooling passage 2306 (FIG. 168) formed in the sealing shoe 2141. After the water passes through the shoe 2141 it flows through a conduit 2307 (FIG. 157) which directs the water through an internal U-shaped cooling passage 2309 (FIG. 164) in the anvil 2136. Another flexible tube 2311 is connected to the passage 2309 and to an internal U-shaped passage 2312 (FIG. 164) in the anvil 2137 thereby directing the cooling water through the anvil 2137. A first coolant return tube 2313 (FIG. 157) is connected between the passage 2312 and a passage in the upper end of the carrier 2146 which communicates with a second return tube 2316 (FIG. 160) which has one end secured to the rotary column 1186 in communication with the transverse outlet passage 2294 which directs the spent coolant out of the top sealing turret 108.

In the operation of the top sealing turret 108 (FIG. 156) it will be understood that the transport conveyor chain 1201 continuously drives the turret, and that each of the filled cartons C with heated top closure flaps are supported by the carriers 1246 directly below associated ones of the eight top sealing heads 2096.

Rotation of the turret 108 causes the cam track 2128 which engages the cam followers 2147 to vertically reciprocate each sealing head 2096 in accordance with the cam diagram illustrated in the FIGURE 180. In FIGURE 180, the starting or 0° position corresponding to the point at which the run of the conveyor chain 1201 entering the sealing turret 108 is tangent to the turret. As indicated in the diagram, each sealing head 2096 remains in the uppermost position for the first 36° of rotation, moves downwardly to its lowermost position during the next 45° of rotation, dwells in the lowermost position for 184°, and then returns to the uppermost position to complete the 360° cycle of operation. During this cycle of operation, the cam track 2129 (FIG. 156) which engages the cam followers 2163 of each sealing head 2096, controls the movement of the multiple faced cam 2161 so that the cam remains in its 0° or inactive position for the first 66° of rotation of the turret. While each sealing head is moved between the 66° and 146° arcuate range of travel of the turret 108, the cam track 2129 shifts the multiple faced cam 2161 (FIG. 162) through its 80° arcuate range to a fully active position as indicated in FIGURE 181. The multiple faced cam 2161 dwells in the fully active position, i.e., in a position wherein sealing pressure is being applied to the top closure of the carton, to the 245° point of turret rotation. The multiple faced cam 2161 then returns to the inactive position during the next approximately 50 degrees of rotation and dwells in the inactive position until the turret 108 completes its cycle of operation.

The movement of the anvils 2136 and 2137, the rear flap support 2139, the sealing shoe's radial movement, and the sealing shoe's sealing movement, are controlled by the cam tracks 2166 and 2167, 2169, 2168 and 2171, respectively, in timed relation as indicated in FIGURE 181. The snap over movement of the folding shoe 2138 is controlled by the cam tracks 2246 and 247 (FIG. 158) as indicated by the line 2318 in FIGURE 181. The radial movement of the folding shoe 2138 is indirectly controlled by the movements of the rear flap support 2139 and the sealing shoe 2141 in accordance with the line 2319 in FIGURE 181.

In order to better understand the operation of the flap engaging components of the top sealing head 2096, these components have been shown in progressive operative stages in pairs of operational views. FIGURES 168 and 169 illustrate the position of the components at the inactive or 0° position illustrated in the diagram of FIGURE 181. FIGURES 170 and 171 illustrate the components when at approximately the 15° position. FIGURES 172 and 173 illustrate the components when at about the 30° position. FIGURES 174 and 175 show the components at approximately the 35° position, while FIGURES 176 and 177 indicated the components when between the 60° and 80° positions. The positions of the components illustrated in FIGURES 178 and 179 are at approximately the 29° position of rotation of the multiple faced cam 2161 when the cam is returning to its inactive position from its active position.

As indicated in FIGURES 168 and 169, a filled carton C, with its top closure flaps preformed and having certain surfaces thereof heated to a bonding temperature, is centered below the top sealing head 2096 with all carton contacting components spaced from the carton. At this time, it will be noted that the T-shaped overcenter locking plate 2238 engages the abutment surface 2243 thereby holding the folding shoe foot 2231 in its uppermost position.

The sealing shoe 2141 and the folding shoe 2138, which folding shoe is connected to the rear flap support 2139 by the aforementioned springs 2213 and pivots with the flap support 2139, then engages the wide lip 153 and narrow lip 152, respectively, of the top closure TC bending the flaps 142 and 143 inwardly as indicated in FIGURE 170. During this time, the anvils 2136 and 2137 (FIG.

171) move inwardly toward the flaps 139 and 141, and below the tabs 146 and 147, respectively. It will also be noted that the carton guides 2181 engage the upper end of the carton to maintain the carton in proper sealing position.

Continued pivotal movement of the sealing shoe 2141 and folding shoe 2138 towards each other causes the cam follower 2137 to engage the cam track 2246 thereby shifting the folding shoe 2231 from a position wherein the T-shaped overcenter locking plate 2238 engages the abutment surface 2244 rather than the abutment surface 2243 as indicated in FIGURE 172. In this way, the narrow lip 152 is bent downwardly relative to the major portion of the flap 143. The overcenter lock spring 2241 (FIG. 167) holds a folding shoe foot 2231 in this position until reset. During this time, the anvils 2136 and 2137 move toward each other to the position indicated in FIGURE 173.

As indicated in FIGURES 174 and 176, a continued inward movement of the sealing shoe 2141 and of the rear flap support 2139 causes the stop bolt 2223 which is supported by the sealing shoe actuator lever 2224 to engage the stop arm 2219 of the folding shoe support yoke 2214 thereby pivoting the stop arm, the folding shoe 2138, and the sealing shoe 2141 in a clockwise direction while the rear flap support 2139 continues to pivot in a counterclockwise direction. In this way, the rear flap support is moved into supporting engagement with the flap 143 and the folding shoe foot 2231 is withdrawn from above the narrow lip 152, permitting the sealing shoe to be pivoted into the sealing position illustrated in FIGURE 176. During this time, the anvils 2136 and 2137 move into sealing position under the tabs 146 and 147, respectively. It will be particularly noted that the top closure flaps are accurately held in sealing position by cooperation between the carton guides 2181, the pins 2183 and the anvils 2136 and 2137, the tapered ends of the anvils, the rear flap support 2139 (FIG. 176) and the sealing shoe 2141.

After the parts have been swung into the sealing position indicated in FIGURES 176 and 177, the cam follower 2287 forces the sealing shoe 2141 downwardly thereby squeezing certain portions of the top closure flaps between the sealing shoe and the anvils 2136 and 2137 causing the polyethylene coated top closure flaps to be bonded together in fluid tight relationship. It will be noted that the spring 2281 (FIG. 160) will compensate for any variations in thickness in top closure flaps and will apply a sealing force of 300 to 400 p.s.i. to the top closure to assure uniform sealing of the top closures of all cartons.

The sealing pressure is maintained on the top closure flaps for approximately 100° of turret rotation, and thereafter, the carton contacting components of the top sealing head 2096 are returned to the inactive or the 0° position. During this return movement, the cam follower 2237 (FIG. 178) of the folding shoe foot 2231 engages the upper cam track 2247 and causes the foot 2231 to shift to its elevated position wherein the overcenter lock spring 2241 (FIG. 157) returns the T-shaped overcenter locked plate 2238 to a position wherein it contacts the locking surface 2243 rather than the surface 2244. The folding shoe foot 2231 remains in this position until the cycle of operation of the top sealing head is completed, the sealed carton is discharged from the top sealing station S20, and another carton has entered the sealing station S20.

MARKING TURRET

After the top closures TC of the carton C have been sealed in the top sealing turret 108 at station S20 (FIG. 2), the transport conveyor chain 1201 and associated carriers 1246 move the sealed cartons into the marking turret 110 at station S21 where a carton identifying indicia is imprinted on the top closure of the carton.

The marking turret 110 includes the aforementioned stationary column 1177 which is bolted to the stationary frame 1132, the rotary tubular drive column 1187 which is journaled on the stationary column 1177, and the drive sprocket 1196. The drive sprocket 1196 and a splash apron 2323 are bolted to a drive hub 2324 which is slidably received on the tubular column 1187. The hub 2324 is supported on the adjustable frame 1137 for movement therewith by an annular support 2326 which is bolted to the adjustable frame 1137 and has the rotary tubular column 1187 and the stationary tubular column 1177 projecting upwardly therethrough. A pair of mating thrust bearings 2327 and 2328 are connected to a flange 2329 on the lower end of the drive hub 2324 and to the annular support 2326, respectively, thereby permitting rotation of the hub 2324 relative to the annular support 2326.

A tool supporting hub 2332 is bolted to the upper end of the tubular drive column 1187 and has an upwardly projecting neck 2333 rotatably received about a reduced diameter portion 2334 of the stationary column 1177. A vertically extending drive post 2335 is bolted to the drive hub 2324 and projects upwardly through a drive block 2336 that is rigidly secured to the tool supporting hub 2332. It will be recognized that the drive post 2335 transmits rotary motion from the drive hub 2324 to the tool supporting hub 2332 yet permits vertical motion of the drive hub 2324 and associated parts relative to the tool supporting hub 2332.

A collector ring housing 2337 is formed integrally on the upper end of the neck 2333 and encompasses three spaced collector rings 2338 which are insulated from each other and are rigidly secured to the stationary column 1177. Electrical power is directed into the collector rings from a power source (not shown) and is transmitted in the usual manner by brushes 2339 riding against the rings and associated conductors to electrical die heating elements 2341 encompassed in each of the four marking heads 2342. A stationary cam track 2343 is keyed to the upper end of the stationary column 1177 and has a downwardly directed skirt 2344 which serves to close the upper end of the collector ring housing 2337.

Four identical marking head assemblies 2346 are secured to the outer periphery of the collector ring housing 2337 at evenly spaced intervals therearound. Each marking head assembly 2346 (FIG. 182) includes a bracket 2347 that is bolted to the housing 2337 and has apertured bosses 2348 and 2349 formed on the upper and lower ends thereof, respectively. The upper boss 2348 has a pivot shaft 2351 secured therein and projecting outwardly from both sides thereof, while the lower boss 2349 has a pivot shaft 2352 secured thereto and projecting outwardly therefrom. An upper link 2353 has one end pivotally supported on the pivot shaft 2351 and another end pivotally supported on a pivot shaft 2354 secured in a boss 2356 (FIG. 182) on the upper end of a marking head support bar 2357. Similarly, a lower link 2358 has one end pivotally supported on the lower pivot shaft 2352 (FIG. 183) and another end pivoted on a pivot shaft 2359 which is secured to a boss 2361 (FIG. 182) of the support bar 2357. A ceramic heat shield 2363 and one of the marking heads 2342 are bolted to the lower flanged end of each of the support bars 2357. Each head 2342 is vertically reciprocated by a cam follower 2364 journaled on the pivot shaft 2354 and positioned to ride along the cam track 2343.

Each marking head 2342 (FIG. 184) comprises a body 2366 which is provided with a cylindrical bore 2367 that receives one of the electrical die heating elements 2341 (FIG. 182) and heats the entire body to a desired marking temperature. The heating element 2341 is held in the marking head 2342 by an angle bracket 2368 bolted to a plate 2369 that is secured to the support bar 2357.

A feature of the invention is that the body 2366 is apertured to slidably receive two marking dies 2371, one of the dies being received in a generally rectangular slot 2372 in the lower surface 2373 of the body 2366 in position to engage and mark the carton, while the other die is held in reserve in a generally rectangular preheating slot 2374 in one side wall 2375 of the body 2366. Thus, both dies 2371 will be maintained at the operative marking temperature making it possible to quickly remove the operative die 2371 from the lower slot 2372 and replace it with the alternate die from the preheating slot 2374 when the marking of one batch of cartons is completed and when it is desired to place different indicia on another batch of cartons.

As indicated in FIGURE 185, each die 2371 comprises a body 2376 having an elongated slot 2377 therein which has an abutment wall 2378 closing one end, and an internally threaded tubular neck 2379 closing the other end. A clamping screw 2381 is screwed into the neck 2379 and is centrally bored to receive the stem 2382 of a pressure applying clamp 2383. A marking block 2384 with suitable letter, numeral or character embossing patterns (not shown) formed on its lower surface 2386 is fitted in the slot 2377 between the wall 2378 and clamp 2383. The marking block 2384 is clamped in place by the clamping screw 2381 and a cooperating lock nut 2388.

In order to hold the dies 2371 from axial movement in their associated slots 2372 and 2374, a shoulder 2389 (FIG. 184) is formed on the outer surface of each die and engages a forward wall 2391 of the body 2366 preventing movement of the dies to the left as viewed in FIGURE 184. An L-shaped locking finger 2392 is pivoted about a capscrew 2393 screwed in the body 2363. The finger 2392 is movable between a position wherein the locking edge 2394 of the finger 2392 engages a shoulder 2396 (FIG. 183) on each die to lock the dies in the associated slot 2372 or 2374 of the body 2366, and a position wherein the edge 2394 is spaced from the shoulders 2396 as indicated in FIGURE 184 permitting the marking dies 2371 to be slidably inserted into or removed from the slots 2372 or 2374 of the marking head body 2366.

In operation of the marking turret 110, the cam track 2343 is contoured to lift each marking head above the upper level of the top closure of the associated carton therebelow as the carton enters the turret 110, and thereafter lowers the marking block 2384 which is heated to a temperature between the range of 550° F.-660° F. onto the upper surface of the carton's top closure TC. The weight of each marking head 2342 is sufficient to cause the heated embossments on the block 2384 to imprint the desired indicia on each of the cartons between the time the marking block 2384 is lowered onto the cartons and is thereafter lifted from the cartons prior to discharge of the cartons from the marking turret 110 at station S21.

DISCHARGE CONVEYOR

After the filled, sealed and marked cartons have been discharged from the marking turret 110 (FIGS. 1 and 2) at station S21, they are advanced by the transport conveyor chain 1201 around the idler sprocket 1202 and toward the sprocket 1204 which is journaled on the shaft 1207. As the cartons C move along a discharge run 2401 (FIG. 186) of the conveyor chain 1201, the cartons are cammed out of the carrier 1246 and onto the discharge conveyor 112 at station S22 for subsequent discharge from the carton forming and filling machine 50 onto a takeaway conveyor or the like (not shown).

The discharge conveyor 112 (FIGS. 186 and 187) comprises an elongated inner support plate 2402 which extends the full length of the conveyor 112 and has a transverse inlet end wall 2403 and a transverse discharge end wall 2404 bolted thereto. Short outer walls 2406 and 2407

are bolted to the end walls 2403 and 2404, respectively. As best shown in FIGURES 188 and 189, upper and lower conveyor guide rails 2408 and 2409, respectively, are positioned below the upper run 2411 and the lower run 2412, respectively, of the discharge conveyor and are bolted to the short outer walls 2406 and 2407. Upper and lower conveyor guide rails 2413 and 2414 are also bolted to the inner support 2402 thereby assuring that the upper run 2411 and the lower run 2412 of the conveyor are guided along a horizontal path.

In order to assure that the discharge run 2401 (FIG. 186) of the transport conveyor chain 1201 is accurately guided along a path wherein the supporting surfaces of the carriers 1246 lie in a plane slightly above that of the upper run 2411 of the discharge conveyor 112, a portion of the rail 2413 and a rail 2416 (FIGS. 186 and 188) slidably engage and maintain the run 2401 of the discharge conveyor in a horizontal position. As indicated in FIGURES 187 and 188, the rail 2416 is mounted on brackets 2418 which are bolted to the inner support plate 2402.

The rear end of the inner support plate 2402 is bolted to a bracket 2419 (FIG. 189) which is, in turn, bolted to the vertically adjustable frame 1137. The forward end of the conveyor 112 is supported by a rod 2421 (FIG. 187) which is secured between the end wall 2403 and the adjustable frame 1137. Thus, the discharge conveyor 112 moves vertically with the adjustable frame 1137 when adjustments are made to accommodate the different sizes of cartons.

The discharge conveyor is defined by an endless conveyor chain 2422 which includes a plurality of interconnected links 2423 of nylon or the like trained around a drive sprocket 2424 and a driven sprocket 2426. The driven sprocket 2426 is journaled on a bolt 2427 secured to the outer wall 2406, and the drive sprocket 2424 is keyed to an output shaft 2428 of a right angle gear box 2429. The gear box 2429 is bolted to the bracket 2419 and is driven from a gear train which includes a drive gear 2432 (FIG. 186) that is secured to the sprocket 1204, an idler gear 2433 journaled on a bolt 2434 secured to the bracket 2419, and a gear 2436 keyed to the input shaft 2437 of the gear box 2429. Thus, the upper run 2411 of the discharge conveyor is driven in the same direction and substantially at the same speed as the discharge run 2401 of the carton transport conveyor chain 1201.

A pair of spaced transfer rails 2438 and 2439 are inclined relative to the direction of movement of the discharge conveyor and are provided to transfer the carton from the carriers 1246 onto the upper run of the discharge conveyor. The transfer rail 2438 is supported by a plurality of brackets 2441 that are bolted to the conveyor guide rails 2408 and 2409. The transfer rail 2439 is secured by brackets 2443 to the brackets 2418 and by a strap 2444 to the bracket 2419. Thus, as the discharge run 2401 of the transport conveyor chain 1201 moves to the right as viewed in FIGURE 186, the transfer rails 2438 and 2439 will gently deflect the cartons from the carriers 1246 onto the discharge conveyor 112 for discharge from the carton forming and filling machine.

CYCLE TIMER

A cycle timer 2450 (FIGS. 190 and 191) is provided to control certain functions of the forming or dry section 52 (FIG. 13) relative to the position of the mandrels of the forming turret 58. These functions will be made apparent in the description of the operation and electrical controls.

The cycle timer 2450 comprises a bracket 2451 (FIGS. 190 and 192) which is bolted to the previously mentioned gear box 291 and has a cam shaft 2452 journaled therein. The cam shaft 2452 is driven by a drive sprocket 2453 that is secured to the previously described sprocket 289a by cooperating cap screws 2454 and tubular spacers 2456.

A drive chain 2457 is trained around the drive sprocket 2453 and around a driven sprocket 2458 keyed to the cam shaft 2452, and drives the cam shaft one revolution for each indexing movement of the carton forming turret 58.

A normally closed, held open zero position cam switch 1CS (FIG. 190) is mounted on the bracket 2451 in position to have its actuating element 2459 momentarily opened by a lobe 2460 of a cam 2461 keyed to the cam shaft 2452 once for each revolution of the cam shaft. A normally opened mandrel clearing cam switch 2CS (FIGS. 190 and 191) is mounted on the bracket 2451 in position to have its actuating element 2462 momentarily closed by a lobe 2463 of a cam 2464 that is keyed to the cam shaft 2452 once for each revolution of the cam shaft. A normally closed vacuum control cam switch 3CS is bolted to the bracket 2451 in position to have its actuating element 2466 momentarily opened by a lobe 2467 of a cam 2468 that is keyed to the cam shaft 2453.

The timing of the cams is such that the zero position switch 1CS is momentarily opened, and the mandrel clearing cam switch 2CS is momentarily closed immediately prior to an indexing movement of the turret 58 when the carton engaging tools of the carton forming section 52 are in their retracted positions spaced from the mandrels 60 and 61. The vacuum control cam switch 3CS is closed during the time the carton blanks B are engaged by the associated erecting mechanism and are being carried from the associated magazine to the mandrel loading position.

OPERATION AND ELECTRICAL CONTROLS

The mechanical operation of the several components of the carton forming and filling machine 50 (FIG. 1) has been included with the description of the components and is controlled by an electrical circuit 2500 illustrated in FIGURES 192-195. Accordingly, the description to follow will be directed mainly to the protective devices in the machine and to the specific functions performed by an operator when operating the machine.

In order to more easily locate the different parts of the electrical circuit in the drawings, reference numerals are placed near the left margin in FIGURES 193-195, and indicate horizontal reference lines which will be referred to in the description to follow. A form section control panel 2498 (FIG. 1) and a fill section control panel 2499 are provided for housing many of the electrical components at locations which are convenient to the operator.

The electrical circuit 2500 is connected to a 220 volt, three phase power source by main lines L1, L2 and L3 (FIG. 192) having a main circuit breaker 1CB therein. A vacuum pump motor 1M is connected to the main lines by leads 2501 having normally open starter contacts 1M-1 therein. The blower motor 5M is connected to the main lines by leads 2502 having starter contacts 5M-1 therein. The form section drive motor 3M is connected to the main lines by leads 2503 having starter contacts 3M-1 therein. The fill section drive motor 4M is connected to the main lines by leads 2504 having contacts 4M-1 therein, and the clean-in-place motor 7M is connected to the main lines by leads 2506 having contacts 7M-1 therein.

The primary coil of a step-down transformer 1T is connected to main lines L1 and L3 and has opposite ends of a 120 volt secondary coil connected to control circuit main lines L4, L5, L6 and L7, L8, L9.

The bottom heating coils 691 (FIG. 192) are divided into a continuous heating section 2507 and a regulating heat section 2508. The heating coils 691 in the continuous heating section 2507 are connected by leads 2509, 2511 and 2512 to the main lines L1, L2 and L3, respectively. Normally open relay contacts 2C-1 are interposed in each of the leads 2509, 2511 and 2512. Thus, the heating coils 691 are operated by 220 volt single phase power.

The heating coils 691 of the regulating heat section 2508 of the bottom air heaters receive power from vari-

able transformers 1VT that are connected to the main lines L1, L2 and L3. The output leads 2513 of the variable transformers 1VT direct single phase, 220 volt power to the bottom heating coils 691 and have normally opened relay contacts 1C-1 interposed therein.

The top heating coils 1991 are also divided into a continuous heating section 2516 and a regulating heating section 2517. The top heating coils 1991 on the continuous heat section 2516 are connected to the main lines L1, L2 and L3 by leads 2518, 2519 and 2521 having normally opened relay contacts 3C-1 therein. The top heating coils 1991 in the regulating heat section 2517 of the top air heaters receive power from variable transformers 2VT that are connected to the main lines L1, L2 and L3. The output leads 2522 of the transformers 2VT direct single phase 220 volt power to the top heating coils 1991 and have normally open relay contacts 4C-1 therein.

As mentioned above, the controls and other portions of the electrical circuit not yet described receive 120 volt single phase current from pairs of control circuit main lines L4, L5, L6 and L7, L8 and L9 when the control power transformer 1T is energized.

In order to prepare the machine for operation, the main circuit breaker 1CB (FIG. 192) is closed and a plant air valve (not shown) is opened directing high pressure air into a pressure switch 1PS (FIG. 193, line 30) which closes upon rise of pressure. A low heat indicating light 8IL (line 29) for the top heater is lighted through a circuit from main line L4 to main line L7 which circuit includes the light 8IL and a control module MOD-1 that is controlled by the thermocouple 2000 (FIGS. 146 and 193) in the top heating turret. Similarly, a low heat indicating light 6IL (line 24) for the bottom heaters is lighted through a circuit from main line L4 to main line L7 which includes a control module MOD-2 that is controlled either by thermocouples 638 (FIGS. 50 and 193) in the upper bottom heating heads 82 that are associated with the upper series of mandrels 60 or by similar thermocouples 638 in the lower bottom heating heads that are associated with the lower series of mandrels 61 depending upon the position of the selector switch 1SS in one of two selected positions. At this time, a "run" indicator light 21IL (FIG. 195, line 90) is lighted indicating that the machine is prepared for starting. The light 21IL is energized through a circuit between main lines L4 and L7 which circuit includes a closed contact 2PB-SS-1 of a push button, filling section drive start switch 2PB-SS (line 86). If the level of the milk, or other liquid in the tank 1685 (FIG. 119A) is low as determined by the flow control valve FCV, a milk level control relay 12CR (line 92) is deenergized causing a circuit to be established between main lines L4 and L7 which circuit includes a closed relay contact 12CR-1 (line 99) and a low milk supply indicator light 23IL. It will be understood that as soon as the air temperature is raised to the desired level, the bottom heater indicating light 5IL (line 23) and the top heater indicating light 7IL (line 28) will be lit.

The closing of the main circuit breakers also effects energization of photoelectric control relays 1CR, 2CR, 3CR, 4CR, 5CR and 6CR (lines 9-18) through independent circuits between main lines L4 and L7. Relays 1CR and 2CR of emergency stack limit detectors are controlled by the photoelectric cells 1108 (FIGS. 82 and 83) and cooperating light sources 1113 each of which is associated with one of the two columns of cartons in the accumulator 56 (FIG. 1). When the associated column of cartons extends to the height of the light source 1113, the associated relay 1CR or 2CR becomes energized. Similarly, the relays 3CR and 4CR, which are high stack detectors, are controlled by the photoelectric cells 1109 and light sources 1114, and become energized in the event the associated column of cartons raises above the light sources 1114. The relays 5CR and 6CR, which are low stack detectors, are controlled by the photoelectric cells

1111 and light sources 1116 and become energized in the event less than three cartons are present in the associated column of cartons. The light sources 1113, 1114 and 1115 receive their power from transformers 2T and 3T (line 4) which, with indicator lights 11L, 21L and 31L, are connected to main lines L4 and L7. In the event the cartons are not properly positioned in their columns in the accumulator, and the associated one or ones of the relays 1CR to 6CR become energized, associated relay contacts 1CR-1 to 6CR-1 are closed thereby lighting associated indicating lights 251L, 261L, 271L, 281L, 291L and 301L.

After the machine has been prepared as above mentioned, the operator actuates a blower-vacuum motor start switch 2PB (FIG. 193, line 33). Actuation of the start switch 2PB completes a circuit between lines L4 and L7 which includes a normally closed stop switch 1PB and a time delay relay TDR which relay is energized thereby closing a normally open contact TDR-1 in a holding circuit 2530 that is parallel with the start switch 2PB and relay contact TDR-2 (line 35). A motor starter relay 1M (line 35) and motor starter relay 5M (line 36) are in parallel with each other and are in series with open contacts TDR-2, and accordingly are energized upon closing of contacts TDR-2 causing relays 1M and 5M to be energized and contacts 1M-2 and 5M-2 (line 34) to close the holding circuit 2530 about start switch 2PB. Relay contacts TDR-1 and TDR-2 remain closed until the circuit is opened to time delay relay TDR. Normally closed overload contacts 1M-OL and 5M-OL in series with starter relays 1M and 5M remain closed unless the associated motors 1M or 5M become overloaded. Energization of the motor starter relays 1M and 5M also closes relay contacts 1M-1 and 5M-1 (FIG. 192) thereby starting the vacuum pump motor 1M and the blower motor 5M.

As the vacuum increases, a vacuum switch 1VS (line 30) closes thereby energizing control relay 7CR through a circuit which includes the closed plant air pressure switch 1PS and the closed vacuum switch 1VS. Energization of the control relay 7CR closes a normally open contact 7CR-1 (line 50) in a form drive cycle control circuit 2532. Thus, unless the plant air pressure valve is open closing 1PS and the vacuum pump is operating closing 1VS, neither the form nor the fill section drives will operate.

As the blower air pressure increases, an air pressure switch 2PS (line 39) closes thereby making the top and bottom air heater circuits available and lighting a blower indicating light 121L (line 46). The heater selector switch 1SS may be shifted from the "off" position illustrated to positions wherein only the bottom heaters operate, only the top heaters operate, or both bottom and top heaters operate.

When the selector switch 1SS is in "bottom heater" position contacts 1SS-1 and 1SS-2 close circuits 2533 and 2534 thereby lighting a bottom heater indicating light 91L (line 37) and energizing control relay 1C. Energization of relay 2C causes relay contact 2C-1 in the continuous bottom heat section 2507 (FIG. 192) to close thereby directing current into the heater coils 691 of the continuous heat section 2507. If the bottom heat thermocouples 638 determine that the air temperature is low, control module MOD-2 will cause a bottom heat regulator section relay BHR (line 22) to remain deenergized holding a normally closed contact BHR-1 (line 40) closed thereby energizing control relay 1C causing relay contacts 1C-1 (FIG. 192) to close and direct current through the bottom heater 691 in the regulating heat section 2508. When the thermocouple 638 that is connected to the control module MOD-2 senses that the temperature is excessive at the bottom heating heads, the regulating heat section relay BHR will be energized thereby opening contact BHR-1 (line 40) deenergizing relay 1C and the bottom heaters 691 in the regulating section 2508. Thus,

the bottom heaters 691 in the regulating section will cycle on and off to provide the proper sealing temperature at the bottom heating heads.

When the selector switch 1SS (line 38) is set in the "top heater" position, contactors 1SS-3 and 1SS-5 close circuits 2536 and 2537 thereby lighting the top heater indicating light 111L (line 45) and maintaining control relay 3C energized while relay 4C cycles in response to opening and closing of relay contact THR-1. Relay contact THR-1 is closed when the top heater thermocouple 2000 (line 26) senses that the temperature is low and causes control relay THR to remain deenergized. Conversely, when the top heater thermocouple senses that the temperature is high, the relay THR is energized through control module MOD-1 causing the relay contact THR-1 (line 43) to open. Thus, relay contacts 3C-1 (FIG. 192) are held closed while relay contacts 4C-1 cycle causing the top heaters 1991 in the continuous heat section 2516 to operate continuously while the top heaters in the regulating section 2517 operate intermittently.

When the selector switch 1SS is set in the "bottom-top" heating position, contacts 1SS-2, 1SS-3, and 1SS-4, 1SS-5 close circuits 2534, 2536, and a circuit 2538, respectively. Control relays 2C and 3C are then continuously energized while control relays 1C and 4C cycle in the manner mentioned above. Energization of relays 2C and 3C closes relay contacts 2C-2 and 3C-2 (line 44) in circuit 2538 thereby lighting combination heating light 101L.

A stamp heat selector switch 10SS (FIG. 195, line 118) closes a circuit between main lines L6 and L9. The circuit includes variable transformers 3VT and 4VT, the slip rings 2338, the brushes 2339, and the four die heating elements 2341. Closing of the switch 10SS also closes a circuit between main lines L6 and L7 to a stamp heater indicating light 241L (line 123). A panel pilot light 41L (line 124) is connected between main lines L6 and L7 and when lit indicates that power is present in these main lines.

Before the form drive motors 3M and fill drive motor 4M (FIG. 192) can be started, a key K (FIG. 194, line 50) is turned on and a "hand-automatic" selector switch 2SS is placed in the "automatic" position as illustrated in FIGURE 194 and thereby lights an "auto" indicating light 131L (line 52). A selector switch 1PB-SS is switched to the "run" position thereby opening a contactor 1PB-SS-1 and closing contactors 1PB-SS-2 and 1PB-SS-3 (line 58). Closing of 1PB-SS-3 lights a "run" indicator light 151L. The form drive cycle control circuit 2532 is then closed between main lines L4 and L7. The circuit 2532 includes the closed key K, closed contacts 3PB-1 and 4PB-1 of emergency stop switches 3PB and 4PB which are located in different areas of the machine, a closed contact 5PB-1 of a normal stop switch 5PB, a closed contact 6PB-1 of another stop switch 6PB located at a different point on the machine, a closed contact 2SS-1 of a selector switch 2SS which is placed in the "automatic" position, the momentarily closed push button contact 1PB-SS-1 which is momentarily closed and thereafter released to return to the open position shown in FIGURE 194, the closed contacts 1CR-2 and 2CR-2 of photoelectric cell relays 1CR and 2CR (line 9), the closed contact 7CR-1 of pressure control relay 7CR (line 30) and the relay 8CR thereby energizing the same. It will be noted that if cartons are stacked in either column of the accumulator to the height of the uppermost photoelectric cells 1108 of the emergency stack limit detectors, that the relay contacts 1CR-2 or 2CR-2 (line 50) will be opened thereby deenergizing control relay 8CR. Energization of relay 8CR closes relay contact 8CR-1 (line 51) in a holding circuit of start switch 1PB-SS which circuit includes the closed contact 1PB-SS-2.

Energization of relay 8CR also closes relay contact 8CR-2 (line 61) which causes energization of the motor

starter 3M (line 60). The circuit to motor starter 3M includes a portion of the circuit 2532 (line 50) a lead 2539, a lead 2541, the closed contact 8CR-2, the motor starter relay 3M, and the normally closed overload contacts 3M-OL of the motor starter relay 3M. Energization of the relay 3M closes relay contacts 3M-1 (FIG. 192) thereby starting the form drive motor 3M and causing form drive indicator light 17IL (line 62) to light. Energization of relay 3M also closes relay contact 3M-2 (line 60) which is in a circuit 2542 that includes the normally closed zero position cam switch 1CS (FIGS. 190 and 194), a closed contact 2SS-2 of selector switch 2SS, and a closed contact 1PB-SS-4. The function of the components of the circuit 2542 will soon be described.

The picking of carton blanks from the two magazines 70 and 71 (FIG. 1) is controlled by vacuum selector switches 5SS, 7SS (FIG. 194, lines 74 and 77), respectively, on the form section panel 2498 (FIG. 1), and 6SS, 8SS, respectively, on the fill section panel 2499. The selector switches 5SS, 6SS and 7SS, 8SS are wired for two-way control thereby permitting the removal of carton blanks from either magazine to be controlled from either the form section or the fill section.

Energization of relay 3M also closes relay contact 3M-3 (line 60) which energizes a solenoid valve 3SOL which directs high pressure air into the cylinder 726 (FIG. 49) of the bottom heater 84 thereby causing the air control valve 716 to be shifted from the partially inactive venting position shown in FIGURE 56 to the active heating position shown in FIGURE 55. When relay 3M is deenergized, it will be apparent that the cylinder 726 will return the valve 716 to the venting position shown in FIGURE 56.

In order to direct vacuum to the upper erecting mechanism 72 (FIG. 26) the upper magazine 70 must contain a sufficient quantity of carton blanks to hold a limit switch 3LS closed. A similar limit switch 4LS (FIG. 43) of the lower magazine 71 is likewise held closed by a sufficient quantity of carton blanks when it is desired to operate the lower erecting mechanism 76. When the switch 3LS (FIG. 194, line 74) is held closed and the selector switches 5SS and 6SS are closed as indicated in FIGURE 194, a solenoid valve 1SOL and a picker vacuum control relay 17CR (line 76) are energized through a circuit which includes normally closed relay contacts 9CR-1 and 10CR-1. Similarly, when the switch 4LS is held closed and the selector switches 7SS and 8SS are closed, a solenoid 2SOL and a control relay 18CR (line 79) are energized through a circuit which includes normally closed relay contacts 11CR-1 (line 77) and 9CR-1 (line 74). When the solenoid valve 1SOL is energized, a vacuum supply conduit to the upper erecting mechanism is opened permitting the carton blanks to be withdrawn from the upper magazine and be erected as described hereinabove. Likewise, when the solenoid valve 2SOL is energized, a vacuum supply conduit to the lower erecting mechanism is opened permitting the carton blanks to be withdrawn from the lower magazine and be erected in the previously described manner.

It is apparent that the vacuum supply to the upper erecting mechanism can be interrupted upon deenergization of the solenoid valve 1SOL (line 74) and that the vacuum supply to the lower erecting mechanism can be interrupted by deenergizing the solenoid valve 2SOL (line 77). However, if such deenergization is permitted to occur during operation after a carton blank has been gripped and has been partially erected but before the carton has been completely erected, a carton jam will occur. Accordingly, the cam switch 3CS (FIGS. 190 and 194, line 76) is held closed during the interval when suction is normally directed to the suction heads, and defines a holding circuit 2543 for the solenoid valve 1SOL and a second holding circuit 2544 for the solenoid valve 2SOL. The holding circuit 2543 includes relay con-

tacts 17CR-1, which, if closed at the time cam switch 3CS is closed, will hold the solenoid valve 1SOL and control relay 17CR energized until the carton picking cycle is completed. Similarly, the holding circuit 2544 includes relay contacts 18CR-1 (line 79) which, if closed at the time the cam switch 3CS is closed, will hold the solenoid valve 2SOL and control relay 18CR energized until the carton picking cycle is completed and the cam switch 3CS opens.

The vacuum supply to the upper erecting mechanism 72 (FIG. 2) will be interrupted if switches 5SS, 6SS, 3LS, contact 9CR-1, or 10CR-1, are opened. Limit switch 3LS opens if the supply of cartons in the upper magazine 70 is low. Normally closed relay contact 10CR-1 will open if the "high stack interlock" relay 10CR (line 80) is energized upon closing of normally opening relay contact 3CR-2. Relay contact 3CR-2 closes if the photoelectric high stack detector control relay 3CR (FIG. 193, line 13) becomes energized.

The vacuum supplied to the lower erecting mechanism 76 (FIG. 2) will be interrupted if solenoid valve 2SOL is deenergized by the opening of one or more of the following contacts or switches which include: relay contacts 9CR-1, 11CR-1 and switches 7SS, 8SS and 4LS. Limit switch 4LS will open if the supply of cartons in the lower magazine 71 is low. Normally closed relay contacts 11CR-1 will open if the "high stack interlock" relay 11CR (line 81) is energized upon closing of normally open relay contacts 4CR-2. Relay contact 4CR-2 closes when the photoelectric high stack detector controls relay 4CR (FIG. 193, line 15) becomes energized. Energization of control relays 10CR and 11CR (lines 80-84) will close relay contact 10CR-2 and 11CR-2, respectively, and closing of either or both contacts 10CR-2 or 11CR-2 will light a high stack detector indicating light 19IL.

In order to start the fill section drive motor 4M (FIG. 192) a fill section drive control circuit 2546 (line 86) is closed between lead 2541 (line 85), that is controlled by the key K (line 50) and the main line L7. The fill section drive control circuit 2546 includes a normally closed, push-button stop switch 9PB, a contact 9SS-1 of a selector switch 9SS which is closed when the selector switch 9SS is set in an automatic position, a "start-run-jog" switch 2PB-SS which has a contactor 2PB-SS-2 that is momentarily closed and thereafter opens when the start button is actuated, a normally closed stop switch 10PB, a relay contact 7CR-2 which is closed when the plant air pressure switch 1PSS and vacuum switch 1VS (line 30) are closed, the closed contact CIP-1 of a clean-in-place selector switch CIP, the motor starter relay 4M and the normally closed overload relay contact 4M-OL. Thus, when the contact 2PB-SS-2 is momentarily closed, the relay 4M is energized closing relay contact 4M-1 (FIG. 192) thereby starting the motor 4M.

Energization of the relay 4M also closes relay contact 4M-2 (line 87) which is in series with a closed contact 2PB-SS-3 and is in parallel with contact 2PB-SS-2 thereby providing a holding circuit for a start switch 2PB-SS. Closing of contact 4M-2 also lights the fill drive indicator light 20IL.

Relay contact 4M-3 (line 103) is closed upon energization of relay 4M thereby energizing sterilizer control relay 15CR causing relay contacts 15CR-1 (line 106) and 15CR-2 (line 110) to close the circuit to the two banks of ultraviolet lights 94 which are energized through transformers 4T. In order to protect the eyes of the operator from the ultraviolet lights, normally closed limit switches 7LS are connected to the door 1010 (FIG. 82) of the housing 1006 which encloses the ultraviolet lights 94 and open thereby breaking the circuit to the lights 94 when the door is opened.

Energization of relay 4M also closes relay contact 4M-4 (line 88) which energizes a solenoid valve 4SOL that directs high pressure air into the cylinder 2026 (FIG. 148) of the top heating turret 106 thereby causing the air

control valve 2016 to be shifted from the partially inactive venting position shown in FIGURE 150 to the active heating position shown in FIGURE 149. It will be apparent that the valve 2016 will be in the venting position of FIGURE 150 when the fill section drive motor 4M (FIG. 192) is stopped.

In order to feed cartons from the accumulator 65 (FIG. 1) into the wet or filling section 54, a sufficient quantity of liquid must be present in the filler tank 1685 (FIG. 119A) to energize the milk level relay 12CR (line 92) thereby closing a relay contact 12CR-1 (line 95), which directs power into a lead 2547, or a toggle switch 1TG must be actuated to open the circuit to the milk level relay 12CR and close another circuit to the lead 2547 which bypasses the contact 12CR-1 and permits emptying of the liquid supply tank of the filling turret.

As mentioned previously, the normally open cam switch 5CS (FIGS. 95 and 195, line 95) is held closed and the normally closed cam switch 6CS is held open when the feed mechanism 96 is in the starting or 0° position shown in FIGURE 95. However, immediately after initiating a feed stroke, the switches 5CS and 6CS return to their normal positions. Thus, a carton feeding cycle is initiated by a circuit which extends from lead 2547 to main line L7 and includes the momentarily closed cam switch 5CS, the closed toggle switches 2TG and 3TG, closed relay contacts 5CR-2 and 6CR-2, which contacts remain closed if three or more cartons are present in each column of the accumulator, and control relays 13CR and 14CR. Energization of relays 13CR and 14CR close relay contacts 13CR-1 (line 97) and 14CR-1 (line 98) thereby maintaining relays 13CR and 14CR energized until completion of the cycle of operation even though the starting circuit is broken to relays 13CR or 14CR upon opening of relay contacts 5CR-2 and 6CR-2. Energization of relays 13CR and 14CR also closes contacts 13CR-2 and 14CR-2 (lines 100 and 101) thereby energizing clutch solenoids 1317 and 1314 (FIG. 96) and causing the feed mechanism 96 to operate continuously.

If it is desired to bypass low stack relay contacts 5CR-2 and 5CR-3, a normally open clear-out switch COS (line 93) is held closed thereby making it possible to remove all cartons from the accumulator 65 (FIG. 1).

The carton forming and filling machine may be stopped in several different ways. The stop switch 1PB (line 33) may be momentarily opened thereby deenergizing motor starter relays 1M and 5M (lines 35 and 36) causing the vacuum pump motor 1M and the blower motor 5M (FIG. 192) to stop. Vacuum then decreases opening vacuum switch 1PS (line 30) thereby deenergizing control relay 7CR. Relay contacts 7CR-1 (line 50) open deenergizing control relay 8CR opening relay contact 8CR-2 (line 61) and deenergizing motor starter 3M (line 60) thus stopping the form drive motor 3M (FIG. 192). Deenergization of control relay 7CR also opens relay contact 7CR-2 (line 86) thereby deenergizing motor starter 4M (line 87) stopping the filling section drive motor 4M (FIG. 192).

During the normal stopping of the form drive, it is desired that the partially formed cartons on the mandrels 60 and 61 (FIG. 1) of the carton forming turret 58 be removed from the mandrels so as to assure that all cartons entering the accumulator 65 will have their bottom closures properly sealed. Normal stopping of the form drive is initiated upon momentary opening of either stop switch 5PB or 6PB (line 50) which switches are located at the form panel 2498 (FIG. 1) and fill panel 2499 of the machine, respectively. Opening of switches 5PB or 6PB deenergizes relay 8CR opening relay contact 8CR-1 (line 51) and 8CR-2 (line 61). However, motor starter relay 3M (line 60) remains energized through a circuit from lead 2539, through normally closed cam switch 1CS, through closed selector switch contact 2SS-2, through closed contact 1PB-SS-4, through closed relay contact 3M-2, through motor starter relay 3M, and

through overload contacts 3M-OL to main line L7. Opening of stop switch 5PB or 6PB momentarily closes switch contacts 5PB-1 and 5PB-2 (lines 64 and 65) or 6PB-1 and 6PB-2 (lines 66 and 67) slightly before 5PB or 6PB (line 50) opens thereby energizing control relay 9CR (line 64) and stepping switch actuating relay 4SS-A (line 65). Energization of 9CR closes relay contact 9CR-2 (line 62) and 9CR-3 (line 68), and energization of stepping switch actuating relay 4SS-A closes relay reset contact 4SS-R1 (line 68) which is mechanically latched in the closed position until reset. Thus, the motor starter relay 3M (line 60) remains energized through a circuit from lead 2541 which includes relay contact 9CR-2 and 3M-2. Energization of control relay 9CR also opens normally closed contacts 9CR-1 (line 74) in the vacuum control system thereby preventing further cartons from being placed on the mandrels.

After the momentarily closed contacts 5PB-1, 5PB-2, 6PB-1 and 6PB-2 have been returned to the open position shown in FIGURE 194, the stepping switch actuating relay 4SS-A is deenergized by opening the cam switch 2CS (line 66) each time the forming turret is indexed thereby deenergizing the stepping switch actuating relay 4SS-A and causing the stepping switch 4SS to step one increment for each indexing movement of the carton forming turret. Each deenergization and subsequent energization causes the stepping switch to shift one step. During this stepping operation the contact 4SS-R1 remains latched closed, and accordingly the circuit to the stepping switch relay 4SS-A includes the lead 2539, the closed contacts 4SS-R1 and 9CR-3, and the cam switch 2CS. After the forming turret stepping switch has indexed six times, the contactor 4SS-1 of the stepping switch 4SS closes against a terminal 2548 (line 69) thereby energizing a stepping switch reset relay 4SS-R (line 71) which resets the stepping switch 4SS to its original position and unlatches the relay contact 4SS-R1 thereby opening the same. The motor starter relay 3M (line 60) remains energized until the normally closed zero position cam switch 1CS (line 60) opens thereby causing the form section drive motor 3M (FIG. 192) to stop when the carton engaging tools of the bottom forming section are spaced from the mandrels 60 and 61 (FIG. 1).

The stepping switch 4SS and its relays 4SS-A and 4SS-R may be Model No. MER115 manufactured by Gardean Electric Manufacturing Company, Chicago, Ill.

In order to stop the fill section drive motor 4M (FIG. 192), stop switches 9PB or 10PB (line 86), which are located in the form section control panel 2498 and fill section control panel 2499, respectively, are momentarily opened. Opening of the switches 9PB or 10PB deenergizes motor starter relay 4M (line 87) thereby stopping the fill section motor 4M.

If an emergency occurs and it is essential that the form section drive motor 3M and fill section drive motor 4M be stopped immediately, stop switches 3PB or 4PB (line 50) are momentarily opened thereby deenergizing relay 8CR opening relay contact 8CR-1 (line 51) and 8CR-2 (line 61). Opening of relay contact 8CR-2 deenergizes motor starter relay 3M (line 60) thereby immediately stopping the form section drive motor 3M.

If at the time it is desired to stop the form drive motor 3M, the motor is under control of the stepping switch 4SS (line 69), stepping switch reset relay 4SS-R is energized upon momentary closing of stop switch contacts 3PB-2 or 4PB-2. Energization of relay 4SS-R opens relay contact 4SS-R1 thereby deenergizing control relay 9CR (line 64) opening contact 9CR-2 (line 62) thereby opening the stepping circuit to the motor starter relay 3M and stopping motor 3M.

Opening of the stop switch contacts 3PB-1 or 4PB-1 (line 50) also breaks the circuit to motor starter contact 4M (line 87) which circuit includes the lead 2539 and 2541 (FIG. 194). Deenergization of motor starter

relay 4M opens relay contacts 4M-1 (FIG. 192) thereby immediately stopping the fill section motor 4M.

It is sometimes desirable to remotely control the form section drive motor 3M or fill section drive motor 4M. Accordingly, a portable remote control panel PCP (FIG. 194, line 54) includes jacks J which may be inserted into receptacles R1 provided in the form section control panel 2498 (FIG. 1) if the form section motor 3M is desired to be remotely controlled. If it is desired to operate the form drive motor 3M by the remote control panel PCP, the jacks J are connected to receptacles R1, as mentioned above, selector switch 2SS (line 50) is placed in a remote control position wherein the contact 2SS-1 opens from drive cycle control circuit 2532 and closes a circuit which includes leads 2549 and causes energization of indicator light 14IL. Selector switch 1PS-SS is actuated so as to open contact 1PS-SS-2 (line 51), open contact 1PS-SS-3 (line 58) that is in series with indicator light 15IL and close 1PS-SS-3 in a circuit in series with an indicator light 16IL thereby lighting the same, and open contact 1PB-SS-4 (line 60) thereby removing the cam switch 1CS from the circuit which controls starter relay 3M. In order to start the form section drive motor 3M, a start switch 8PB (line 57) is momentarily closed thereby closing a circuit to relay 8CR (line 50) which includes the lead 2549, a closed stop switch 7PB, the momentarily closed start switch 8PB, and the relay 8CR which is energized. Energization of relay 8CR closes relay contacts 8CR-1 (line 51) thereby holding relay 8CR energized through a circuit which includes a "run-jog" selector switch 3SS which is closed as shown when in the run position. Energization of relay 8CR closes relay contact 8CR-2 (line 61) which energizes motor starter relay 3M and accordingly starts the form section drive motor 3M (FIG. 192) upon closing contact 3M-1. If it is desired to jog the motor 3M, the run jog switch 3SS is opened and the circuit to relay 8CR is alternately energized and deenergized by closing or opening the start switch 8PB.

If it is desired to control the fill motor 4M (FIG. 192) by means of the portable control panel PCP, the jacks J of the panel are connected to the receptacles R2 (line 88). The contact 9SS-1 (line 86) of selector switch 9SS is opened to break the fill drive control circuit 2546 and is closed in a circuit 2551 which directs power into the portable control panel PCP when connected to receptacles R2. The switch 2PB-SS is also actuated to open contact 2PB-SS-2 (line 86), open contact 2PB-SS-1 (line 90) thereby extinguishing indicating light 21IL and closing contact 2PB-SS-1 in a circuit which includes jog indicating light 22IL thereby lighting the same. The control panel PCP is operated in the same manner as when connected to the form drive panel 2498 except that the relay 4M is energized directly from the panel PCP rather than through an intermediate control relay.

The clean-in-place drive motor 7M (FIG. 192) is interlocked with the fill drive circuit 2546 (line 86) by the switch CIP to prevent simultaneous operation of the two drives. When operating the clean-in-place motor 7M, a contact CIP-2 of the interlock switch CIP is closed and the contact CIP-1 is opened. A start switch 11PB is closed thereby energizing starter relay 7M closing holding contact 7M-2 (line 86) and relay contacts 7M-1 (FIG. 192) thereby starting the clean-in-place motor 7M. A normally closed stop switch 12PB (line 85) is included in the circuit with relay 7M, and when opened, deenergizes relay 7M and stops the clean-in-place motor 7M.

From the foregoing description, it is apparent that the carton forming and filling machine of the present invention broadly provides an intermittently driven carton forming section which closes the bottom closures of the cartons, a continuously driven filling section which fills and closes the tops of the cartons and is driven independently of the forming section, and an accumulator disposed between the forming section and the filling section which

sterilizes the cartons and stores a sufficient number of cartons therein to permit either the fill section or the form section and accumulator, to operate independently for a limited time. Thus, the form section may be operated so as to clear cartons therefrom when the fill section is inoperative; and conversely, the fill section may be operated when the forming section and accumulator are inoperative.

Although the machine 50 is used primarily for the purpose of packaging liquid dairy products, it is understood the machine is capable of handling other flowable material, and that the term "liquid" as used in the claims is to be construed broadly enough to include such flowable material.

While one embodiment of the present invention has been shown and described, it will be understood that various changes and modifications may be made without departing from the spirit of the invention or the scope of the appended claims.

The present invention and the manner in which the same is to be used having thus been described, what is claimed as new and desired to be protected by Letters Patent is:

1. A machine for forming and filling cartons each of which includes a bottom closure and a stop closure; the combination of a forming section having means for erecting cartons from carton blanks and having means for sealing the bottom closures of each carton; an accumulating section including a vertically extending accumulating conveyor driven at a predetermined speed, a plurality of evenly spaced carriers on said conveyor, means for transferring cartons from said forming section onto said carriers, and a carton accumulating guideway for receiving cartons from said conveyor and for accumulating a vertical stack of abutting cartons; a filling section including means for filling each carton and means for sealing the top closure of each carton, and means for transferring the cartons from said stack to said filling section at a speed determined by the demand for cartons from said filling section.

2. A machine for forming and filling cartons each of which includes a bottom closure and a top closure, the combination of a forming section having means for erecting cartons from carton blanks and having means for sealing the bottom closures of each carton, an accumulating section including means for accumulating a supply of cartons having their bottom closures sealed and their top closures open, a filling section including means for filling each carton and means for sealing the top closure of each carton, first drive means for intermittently driving said erecting means and said bottom sealing means and for continuously driving said accumulating means, second drive means independent of said first drive means for continuously driving said filling means and said top sealing means, and control means for detecting the minimum desired number of accumulated cartons in said accumulating section and for precluding transfer of cartons from said accumulating section to said filling section when the number of accumulated cartons is less than said minimum number of cartons.

3. A machine for forming and filling cartons each of which includes a bottom closure and a top closure comprising a forming section having means for simultaneously erecting a plurality of rows of cartons from tubular carton blanks and having means for simultaneously sealing the bottom closures of the cartons in said plurality of rows, an accumulating section including means for accumulating a supply of cartons in a plurality of rows each of which corresponds to one of said rows in said forming section, a filling section including means for receiving the cartons from said accumulating means in a single row from said plurality of rows and including means for filling each carton and means for sealing the top closure of each carton, and transfer means for simultaneously transferring cartons from each of said plurality

of rows of accumulated cartons for acceptance in the single row of cartons in said filling section.

4. An apparatus according to claim 3 wherein control means are provided for detecting the minimum desired number of cartons in said accumulating section and for precluding transfer of cartons from said accumulating section to said filling section when the number of accumulated cartons is less than said minimum number of cartons.

5. An apparatus according to claim 3 wherein the cartons in the plurality of rows in said forming section are moving at a predetermined speed and wherein the cartons in said single row in said filling section are moving at a speed substantially equal to the sum of the speeds of all of said plural number of rows in said forming section.

6. A machine for forming and filling cartons each of which includes a bottom closure and a top closure, comprising a forming section having means for erecting cartons from tubular carton blanks and having means for sealing the bottom closures of each carton, an accumulating section including an accumulator for accumulating a supply of cartons having their bottom closures sealed and their top closures open, a low level detector in said accumulation section for detecting the minimum desired number of cartons in said accumulator, a filling section including means for filling each carton and means for sealing the top closure of each filled carton, means for transferring cartons from said accumulator to said filling section, first drive means for intermittently driving said erecting means and said bottom sealing means and for continuously driving said accumulating means, second drive means independent of said first drive means for continuously driving said filling means and said top sealing means, and for intermittently driving said transferring means, and control means connected between said low level detector and said second drive means for deactivating said transfer means in the event a number of cartons less than said minimum desired number is detected by said low level detector.

7. A machine for forming and filling cartons each of which includes a bottom closure and a top closure, comprising: a forming section having means for erecting cartons from flat folded blanks into tubular carton blanks and having means for sealing the bottom closures of each carton; an accumulating section including an accumulator for storing a supply of cartons having their bottom closures sealed and their top closures open, a low level detector in said accumulating section for detecting the minimum desired number of cartons in said accumulating section, a high level detector in said accumulating section for detecting the maximum desired number of cartons in said accumulating section; a filling section including means for filling each carton and means for sealing the top closure of each carton; means for intermittently transferring cartons from said accumulating section to said filling section; first drive means for intermittently driving said erecting means and said bottom sealing means and for continuously driving said accumulating means; second drive means independent of said first drive means for continuously driving said filling means and said top sealing means; and for intermittently driving said transfer means; and control means connected between said detectors and said first and second drive means and arranged to deactivate said erecting means in the event a number of cartons greater than said highest permissible number is detected by said high level detector, said control means also being arranged to deactivate said transfer means in the event a number of cartons less than said minimum desired number is detected by said low level detector.

8. A machine for forming and filling cartons each of which includes a bottom closure and a top closure, the combination of: a forming section comprising means for erecting cartons from carton blanks, means for sealing the bottom closure of each carton, and means for adjusting said erecting means and said sealing means to handle

cartons of different sizes; an accumulating section comprising means for accumulating a plurality of cartons, and means for adjusting said carton accumulating means for handling cartons of different sizes; and a filling section comprising means for filling the cartons, means for sealing the filled cartons, and means for adjusting said filling means and sealing means to handle cartons of different sizes, said last mentioned adjusting means being arranged to change the position of the bottom of the cartons and a portion of the filling means to the nearest one-thousandth of an inch so as to accurately control the quantity of liquid being filled into each carton.

9. A machine for forming and filling cartons each of which includes a bottom closure and a top closure, the combination of: a forming section comprising means for erecting cartons from carton blanks, means for sealing the bottom closure of each carton, means for intermittently advancing the cartons between said erecting means and said sealing means, and means for adjusting said erecting means and said sealing means to handle cartons of different sizes; an accumulating section comprising means for intermittently receiving cartons from said forming section and for continuously advancing the cartons through a portion of said accumulating section, stationary means for supporting a row of cartons in said accumulating section, and means for adjusting said carton accumulating means and said row supporting means for handling cartons of different sizes; and a filling section comprising continuously driven means for receiving the cartons from said stationary accumulating support means and for advancing the cartons through a plurality of stations, means at one station for filling the cartons, means at another station for sealing the filled cartons, and means for simultaneously adjusting said filling means and said sealing means to handle cartons of different sizes, said last mentioned adjustment means being arranged to change the position of the bottom of the cartons and a portion of the filling means to the nearest one-thousandth of an inch so as to accurately control the quantity of liquid being filled into each carton.

10. A machine for forming and filling thermoplastic cartons each of which includes a bottom closure and a top closure, comprising: a forming section including means for erecting cartons from flat folded blanks into tubular carton blanks, means for directing hot air at said bottom closures to heat certain portions of the bottom closures to a bonding temperature, and pressure applying means for sealing the bottom closures of each carton; an accumulating section comprising a continuously driven vertically extending conveyor having spaced carriers thereon, means for transferring the cartons from said forming section onto said carriers of said vertical conveyor, and means for receiving the cartons from said vertical conveyor and accumulating the cartons in a vertical stack of abutting cartons; a filling section including means for transferring the cartons from the vertical stack to the filling section at a speed determined by the demand for the cartons from the filling section, means for filling each carton, means for directing hot air at the top closure of each carton for heating certain portions of the top closures to a bonding temperature, and pressure applying means for sealing the top closure of each carton; first drive means for intermittently driving said erecting means and said bottom sealing means and for continuously driving said accumulating means; second drive means independent of said first drive means for continuously driving said filling means and said top sealing means; and control means associated with said accumulating section and with said first and second drive means and arranged upon detecting an excessive quantity of accumulated cartons in said accumulating section to deactivate said first drive means while permitting said second drive means to continue operating.

11. In a machine having a plurality of stations for forming and filling cartons each of which includes a bot-

tom closure and a top closure, the combination of: a forming section comprising means for erecting tubular carton blanks from flat folded blanks, means for supporting said blanks and for moving said blanks past said stations, means at said stations for sealing the bottom closures of the cartons, means for discharging the cartons from said support means, and first drive means for driving said support means for moving said cartons between said stations; an accumulating section comprising a continuously driven conveyor having carton supporting carriers thereon, means for transferring the cartons from said support means to said carriers, means for receiving the cartons from said conveyor and accumulating the cartons in a vertical stack of abutting cartons, and maximum quantity detecting means for detecting the maximum permissible quantity of cartons in said vertical stack; a filling section comprising conveying means for receiving each carton, means for filling each carton while the cartons are supported on said conveying means, means for sealing the top closure of each carton while the cartons are supported on said conveying means, and second drive means for driving said conveying means; and control means responsive to the detection by said maximum quantity detecting means of a supply of cartons in said accumulating means greater than said maximum permissible quantity for immediately deactivating said erecting means, said second drive means being unaffected when said detecting means detects a supply of cartons in excess of said maximum permissible quantity.

12. In a machine having a plurality of stations for forming and filling cartons each of which includes a bottom closure and a top closure, the combination of: a forming section comprising means for erecting tubular carton blanks from flat folded blanks, means for supporting said blanks and for moving said blanks past said stations, means at said stations for sealing the bottom closures of the cartons, means for discharging the cartons from said support means, and first drive means for driving said support means for moving said cartons between said stations; an accumulating section comprising means for receiving the cartons from said forming section with their bottom closures sealed, means for accumulating a row of cartons, and minimum quantity detecting means for detecting the minimum permissible quantity of cartons in said accumulating means; a filling section comprising conveying means for receiving each carton, means for intermittently transferring each carton from said accumulating means to said conveying means, means for filling each carton while the cartons are supported on said conveying means, means for sealing the top closure of each carton while the cartons are supported on said conveying means, and second drive means for driving said conveying means and said transfer means; and control means responsive to the detection by said minimum quantity detecting means of a supply of cartons in said accumulating means less than said minimum permissible quantity for deactivating said transfer means and allowing said first drive means to operate.

13. In a machine having a plurality of stations for forming and filling cartons each of which includes a bottom closure and a top closure, the combination of: a forming section comprising means for erecting tubular carton blanks from flat folded blanks, means for supporting said tubular blanks and for moving said blanks past said stations, means at said stations for sealing the bottom closure of the blanks to form open-top cartons, means for discharging the cartons from said support means, and first drive means for driving said support means for moving said cartons between said stations; an accumulating section comprising means for receiving the cartons from said forming section with their bottom closures sealed, means for accumulating a row of cartons, maximum quantity detecting means for detecting the maximum permissible quantity of cartons in said accumulating means, and minimum quantity detecting means for detecting the minimum

permissible quantity of cartons in said accumulating means; a filling section comprising conveying means for receiving each carton, means for transferring each carton from said accumulating means to said conveying means, means for filling each carton while the cartons are supported on said conveying means, means for sealing the top closure of each carton while the cartons are supported on said conveying means, and second drive means for driving said conveying means; and control means responsive to the detection by said maximum quantity detecting means of a supply of cartons in said accumulating means greater than said maximum permissible quantity for immediately deactivating said erecting means, said second drive means being unaffected when said detecting means detects a supply of cartons in excess of said maximum permissible quantity, said control means also being responsive to the detection by said minimum quantity means of a supply of cartons in said accumulating means less than said minimum permissible quantity for deactivating said transfer means and for allowing said first drive means to continue to operate.

14. In a machine having a plurality of stations for forming and filling thermoplastic cartons each of which includes a bottom closure and a top closure, the combination of: a forming section comprising means for supporting a plurality of flat folded carton blanks having flaps at one end, means for erecting the carton blanks into open ended rectangular tubes, an intermittently driven carton-forming turret disposed adjacent said carton erecting means, a plurality of mandrels projecting radially outward from said turret, each mandrel being movable between said stations, first drive means for intermittently driving said turret, means at one station for inserting each tube onto a mandrel with its bottom closure projecting outwardly therefrom, means at another station for preforming the bottom closure by bending certain of said flaps inwardly, means at other stations for heating certain portions of each bottom closure to a bonding temperature, means at other stations for applying pressure to the heated bottom closures to seal the bottom closures, and means at another station for withdrawing each carton from said associated mandrel; an accumulating section comprising a continuously driven conveyor, means for deflecting the cartons withdrawn from said mandrel onto said conveyor, and means for receiving the cartons from said conveyor and accumulating the cartons in a row of abutting cartons; and a filling section comprising a continuously driven transport conveyor for receiving the cartons one at a time and for advancing the cartons along a predetermined path, means for filling the cartons as the cartons are moving along said path, means for sealing the cartons while the cartons are moving along another portion of said predetermined path, and second drive means for continuously driving said transport conveyor.

15. In a machine having a plurality of stations for forming and filling cartons each of which includes a bottom closure and a top closure, the combination of: a forming section comprising means for erecting tubular carton blanks from flat folded blanks, means for supporting said blanks in a plurality of rows and for moving said blanks along a plurality of paths past said stations, means at said stations for sealing the bottom closures of the cartons, means for discharging the cartons from said support means into a plurality of pick-up positions, and first drive means for driving said support means for moving said cartons between said stations; an accumulating section comprising conveying means for receiving each row of cartons from said plurality of pick-up positions and for advancing each row along a predetermined path, means for independently accumulating each row of cartons, and minimum quantity detecting means for independently detecting the minimum permissible quantity of cartons in each row of said accumulating means; a filling section comprising a single transport conveyor for receiving the cartons from all rows in said accumulating means and for advancing the cartons along a single path, independently

operated transfer means associated with each row of cartons in said accumulating section for transferring the cartons from said accumulating section to said transport conveyor, means for filling each carton while the cartons are supported on said conveying means, means for sealing the top closure of each carton while the cartons are supported on said conveying means, and a second drive means for driving said transport conveyor; and control means responsive to the detection by said minimum quantity detecting means of a supply of cartons in each row of said accumulating means less than said minimum permissible quantity for deactivating said associated transfer means.

16. In a machine having a plurality of stations for forming and filling cartons each of which includes a bottom closure and a top closure, the combination of a forming section comprising a plurality of means for erecting tubular carton blanks from flat folded blanks, means for supporting said tubular blanks in a plurality of rows and for moving said blanks along a plurality of paths past said stations, each of said paths corresponding with one of said erecting means, means adjacent said stations for sealing the bottom closures of the cartons, means for discharging the cartons from said support means into a plurality of pick-up positions, and first drive means for driving said support means for moving said cartons between said stations; an accumulating section comprising conveying means for receiving each row of cartons from said plurality of pick-up positions and for advancing each row along a separate path, means connecting said conveying means to said first drive means, means for independently accumulating each row of cartons, maximum quantity detecting means for independently detecting the maximum permissible quantity of cartons in each row of said accumulating means, emergency detecting means for independently detecting a predetermined number of cartons in excess of said maximum permissible quantity in each row of said accumulating means, and minimum quantity detecting means for independently detecting the minimum permissible quantity of cartons in each row of said accumulating means; a filling section comprising a single transport conveyor for receiving the cartons from all rows in said accumulating means and for advancing the cartons along a single path, independently operated transfer means associated with each row in said accumulating section for transferring the cartons from said accumulating section to the transport conveyor, means for filling each carton while the cartons are supported on said transport conveyor, means for sealing the top closure of each carton while the cartons are supported on said transport conveyor, and second drive means for driving said transport conveyor; and independent control means for each accumulated row of cartons and responsive to the detection by said maximum quantity detecting means of a supply of cartons in excess of said maximum permissible quantity to deactivate said corresponding erecting means, said control means being responsive to the detection by any one of said emergency detecting means upon detecting said predetermined quantity of cartons in excess of said maximum permissible quantity in any of said accumulated rows of cartons for deactivating said first drive means, said control means being responsive to the detection by one of said minimum quantity detecting means upon detection of a quantity of cartons less than said minimum quantity in one of said rows of said accumulating means to deactivate the transfer means associated with said one row.

17. In a machine having a plurality of stations for forming and filling thermoplastic cartons each of which includes a bottom closure and a top closure having a plurality of flaps, the combination of: a forming section comprising means for supporting a plurality of tubular carton blanks, means for erecting the carton blanks into open ended rectangular tubes, an intermittently driven carton forming turret disposed adjacent said carton erecting means, a plurality of mandrels projecting radially out-

ward from said turret, each mandrel being movable between said stations, first drive means for intermittently driving said turret, means at one station for moving each tube onto a mandrel with its bottom closure projecting outwardly therefrom, means at another station for preforming the bottom closure by bending certain flaps inwardly, means at other stations for heating certain portions of each bottom closure to a bonding temperature, means at other stations for applying pressure to the heated bottom closures to seal the bottom closures, and means at a subsequent station for withdrawing each carton from said associated mandrel; an accumulating section comprising a continuously driven conveyor, means for deflecting the cartons withdrawn from said mandrel into said conveyor, and means for receiving the cartons from said conveyor and accumulating the cartons in a row of abutting cartons; a filling section comprising a continuously driven transport conveyor for receiving the cartons one at a time and for advancing the cartons along a predetermined path, means for filling the cartons as the cartons are moving along said path, means for sealing the cartons while the cartons are moving along another portion of said predetermined path, and second drive means for continuously driving said transport conveyor; and control means including forming section drive stop means which when activated effects the deactivation of said erecting means upon completion of an erecting cycle, and effects delayed deactivation of said first drive means after the cartons on said mandrels have been sealed and have been discharged from said mandrels.

18. In a machine having a plurality of stations for forming and filling thermoplastic cartons each of which includes a bottom closure and a top closure having flaps formed thereon, the combination of: a forming section comprising means for supporting two rows of flat folded tubular carton blanks, independent erecting means for each row of cartons for erecting the carton blanks into open ended rectangular tubular blanks and for discharging the tubular blanks from each erecting means into a separate mandrel loading station, an intermittently driven carton forming turret disposed adjacent said carton erecting means, a plurality of mandrels projecting radially outward from said turret with said mandrels being arranged in two spaced rows and with each mandrel being movable past said stations upon actuation of said turret, first drive means for intermittently driving said turret, blank loading means at one of said stations for transferring the tubular carton blanks from said mandrel loading station onto the mandrels in each of said two spaced rows with the bottom closures projecting outwardly, means at another station for preforming the bottom closures of the cartons in both rows by bending certain carton flaps inwardly, means at another station for directing hot air at certain portions of each bottom closure to heat each bottom closure to a bonding temperature, means at another station for applying pressure to the heated bottom closures to seal the bottom closures, and means at another station for withdrawing the cartons from the two rows of mandrels and for depositing the two rows of cartons in two accumulator pick-up positions; an accumulator section comprising two continuously driven accumulator conveyors with one conveyor being arranged to handle the cartons in one row and the other conveyor being arranged to handle the cartons in the other row, means for transferring each row of cartons into the associated accumulator conveyor while rotating the cartons 90° about their longitudinal axes, sterilizing means disposed in the path of movement of the cartons on said accumulator conveyor for sterilizing the cartons, a carton accumulating guideway associated with each accumulator for receiving and accumulating a stack of cartons from the associated accumulating conveyor, maximum quantity detecting means for independently detecting the maximum permissible quantity of cartons in each of said accumulating guideways, emergency detector means for independently detecting a predetermined number of

cartons in excess of said maximum permissible quantity in each of said accumulating guideways, and minimum quantity detecting means for independently detecting the minimum permissible quantity of cartons in each of said accumulating guideways, and means for interconnecting said accumulator conveyors with said first drive means for continuously driving the same in timed relation with said forming turret; a filling section comprising a single transport conveyor for receiving the cartons from both of said accumulating guideways and for advancing the cartons along a single path, independently operated transfer means for transferring the cartons from each of said accumulating guideways onto said transport conveyor while shifting each carton 90° about an axis perpendicular to its longitudinal axis and also 90° about its longitudinal axis, second drive means for driving said transport conveyor and said transfer means independently of said first drive means and independently of said carton forming turret, a crimping turret driven by said transport conveyor and having means for crimping tabs of the top closure of each carton outwardly while slightly tearing the points of connection of the tabs with the remaining portion of the top closures and while the top closures are supported by said transport conveyor, a top forming turret driven by said transport conveyor and having means for bending certain flaps of the top closure of each carton inwardly when the cartons are supported on said transport conveyor, a filling turret driving by said transport conveyor and having means for filling the cartons with a flowable material when the cartons are supported on said transport conveyor, a heating turret driven by said transport conveyor and having means for directing hot air at certain surfaces of the top closure flaps and tabs of the cartons while the cartons are supported on said transport conveyor to heat said thermoplastic material to a bonding temperature, a top sealing turret driven by said transport conveyor and having means for sealing the top closures of the cartons while the cartons are supported on said transport conveyor, a top marking turret driven by said transport conveyor and having means for marking a carton identifying indicia on the top closures of the carton when the cartons are supported on said transport conveyor, and means driven by said transport conveyor for discharging the filled and sealed cartons from said transport conveyor; and means for adjusting said forming section, said accumulating section, and said filling section so as to handle cartons of different sizes.

19. A method of forming and filling cartons each of which includes a top closure and a bottom closure, comprising the steps of erecting flat folded carton blanks into open ended tubular carton blanks, moving the tubular carton blanks along a predetermined path at a predetermined rate, sealing the bottom closures of the cartons while in said path, accumulating a vertically extending stack of cartons having their bottom closures sealed at said predetermined rate, retiming and transferring the cartons from said accumulated stack, advancing the transferred cartons along a second path, filling the cartons while moving along one portion of said second path, and sealing the cartons while moving along another portion of said second path.

20. A method of forming and filling cartons each of which includes a top closure and a bottom closure comprising the steps of erecting two rows of open ended tubular carton blanks, intermittently moving the two rows of tubular carton blanks along a pair of parallel paths at a predetermined speed, sealing the bottom closures of the cartons in both rows while in said path, accumulating the cartons having their bottom closures sealed into two rows at said predetermined speed, retiming and transferring the two rows of accumulated cartons at a different speed, receiving and continuously advancing the two rows of cartons along a single path and at a speed in excess of about twice that of said predetermined speed, filling the cartons while moving along one portion of said single

path, and sealing the cartons while moving along another portion of said single path.

21. A method of forming and filling cartons each of which includes a top closure and a bottom closure comprising the steps of erecting two rows of open ended tubular carton blanks, intermittently moving the two rows of tubular carton blanks along a pair of parallel paths at a predetermined speed, sealing the bottom closures of the cartons in both rows while in said paths, accumulating the cartons having their bottom closures sealed in two rows at said predetermined speed, separately detecting the minimum permissible quantity of accumulated cartons in each row, retiming and transferring the two rows of accumulated cartons at a different speed, independently interrupting the transfer of cartons from either row of accumulated cartons upon the detection of a number of accumulated cartons less than said minimum permissible number, receiving and continuously advancing the transferred cartons along a single path and at said different speed, filling the cartons while moving along one portion of said single path, and sealing the cartons while moving along another portion of said single path.

22. A method of forming and filling cartons each of which includes a top closure and a bottom closure comprising the steps of erecting two rows of open ended tubular carton blanks, intermittently moving the two rows of tubular carton blanks along a pair of parallel paths at a predetermined speed, sealing the bottom closures of the cartons in both rows while in said paths, accumulating the cartons having their bottom closures sealed in two rows at said predetermined speed, separately detecting the maximum permissible quantity of accumulated cartons in each row, retiming and transferring the two rows of accumulated cartons at a different speed, independently interrupting the erecting of the carton blanks in either of said two rows upon the detection of a number of accumulated cartons in the associated row greater than said maximum permissible number, receiving and continuously advancing the two rows of cartons along a single path and at a speed in excess of about twice that of said predetermined speed, filling the cartons while moving along one portion of said single path, and sealing the cartons while moving along another portion of said single path.

23. A method of forming and filling cartons each of which includes a top closure and a bottom closure comprising the steps of sealing the bottom closures of the cartons, accumulating a supply of cartons at a predetermined speed in two vertical stacks having their bottom closures sealed, transferring the cartons from said two vertical stacks, advancing the transferred cartons along a predetermined path at a speed in excess of about twice said predetermined speed, filling the cartons during movement of the cartons along one portion of said path, sealing the cartons while they move along another portion of said path, and controlling the transfer of cartons independently of the rate of sealing of the bottom closures and dependent upon the rate of advancement of the cartons along said predetermined path.

24. A method of forming and filling cartons each of which includes a top closure and a bottom closure comprising the steps of sealing the bottom closures of the cartons, accumulating a supply of cartons having their bottom closures sealed, detecting the minimum permissible and maximum permissible quantity of accumulated cartons, transferring the cartons from said accumulated supply, advancing the transferred cartons along a predetermined path, filling the cartons while moving along one portion of said path, sealing the cartons while moving along another portion of said path, controlling the transfer of cartons independently of the sealing of the bottom closures of the cartons and dependent upon the rate of advancement of the cartons along said predetermined path, and interrupting the transfer of cartons upon detec-

tion of a number of accumulated cartons less than said minimum permissible number.

25. A method of forming and filling cartons each of which includes a top closure and a bottom closure comprising the steps of erecting open ended tubular blanks from flat folded carton blanks, sealing the bottom closures of the cartons, accumulating a supply of cartons having their bottom closures sealed, detecting the minimum permissible and maximum permissible quantity of accumulated cartons, transferring the cartons from said accumulated supply, advancing the transferred cartons along a predetermined path, filling the cartons while they are moved along one portion of said path, sealing the cartons while they are moved along another portion of said path, controlling the transfer of cartons independently of the sealing of the bottom closures of the cartons and dependent upon the rate of advancement of the cartons along said predetermined path, interrupting the transfer of cartons upon the detection of a number of accumulated cartons less than said minimum permissible number, and interrupting the erection of carton blanks upon detection of a number of accumulated cartons greater than said maximum permissible number.

26. A method of forming and filling cartons each of which includes a top closure and a bottom closure comprising the steps of erecting open ended tubular carton blanks from flat folded carton blanks, supporting the tubular carton blanks with their bottom closures outermost, intermittently advancing said blanks along a predetermined path past a plurality of processing stations, sealing the bottom closures of the cartons at said stations, accumulating a supply of the cartons having their bottom closures sealed, detecting the minimum permissible and maximum permissible quantity of accumulated cartons, transferring the accumulated cartons from said accumulated supply, continuously advancing the transferred cartons along a predetermined path, filling the cartons while moving along one portion of said path, sealing the cartons while moving along another portion of said path, controlling the transfer of cartons independently of the sealing of the bottom closures of the cartons and dependently upon the rate of advancement of the cartons along said predetermined path, interrupting the transfer of cartons upon the detection of a number of accumulated cartons less than said minimum permissible number, and interrupting the erection of carton blanks upon the detection of a number of accumulated cartons greater than said maximum of permissible number.

27. In a carton forming and filling machine, an accumulating section for accumulating a supply of cartons having their bottom closures sealed and their top closures open comprising, an accumulating conveyor arranged to be driven at a predetermined rate, a plurality of evenly spaced carriers on said conveyor, means for placing a carton on each carrier, a carton accumulating guideway for stripping the cartons from said carriers and for accumulating a supply of abutting cartons therein, means for maintaining the accumulated cartons in said guideway, and means for deflecting one carton at a time from said guideway upon demand and at a rate independent of the rate of movement of said conveyor.

28. In a carton forming and filling machine, an accumulating section for accumulating a supply of cartons having their bottom closures sealed and their top closures open comprising, an accumulating conveyor driven at a predetermined rate, a plurality of evenly spaced carriers on said conveyor, means for placing a carton on each carrier, means disposed adjacent a run of said conveyor for sterilizing the cartons as they move therepast, a carton accumulating guideway for stripping the cartons from said carriers and for accumulating a supply of cartons therein, means for maintaining the accumulated cartons in said guideway, and means for deflecting one carton at a time from said guideway upon demand and at a rate independent of the rate of movement of said conveyor.

29. In a carton forming and filling machine, an accumulating section for accumulating a supply of cartons having their bottom closures sealed and their top closures open comprising, an accumulating conveyor driven at a predetermined rate, a plurality of evenly spaced carriers on said conveyor, means for placing a carton on each carrier, a carton accumulating guideway for stripping the cartons from said carriers and for accumulating a supply of cartons therein, means for maintaining the accumulated cartons in said guideway, means for deflecting one carton at a time from said guideway upon demand at a rate independent of the rate of movement of said conveyor, and means for adjusting the size of said guideway to accommodate cartons of different sizes.

30. In a carton forming and filling machine, an accumulating section for accumulating a supply of cartons having their bottom closures sealed and their top closures open comprising, an accumulating conveyor driven at a predetermined rate, a plurality of evenly spaced carriers on said conveyor, means for placing a carton on each carrier, means disposed adjacent a run of said conveyor for sterilizing the cartons as they move therepast, a carton accumulating guideway for stripping the cartons from said carriers and for accumulating a supply of cartons therein, means for maintaining the accumulated cartons in said guideway, means for deflecting one carton at a time from said guideway upon demand and independently of the movement of said conveyor, and means for adjusting the size of said guideway to accommodate cartons of different sizes.

31. In a carton forming and filling machine, an accumulating section for accumulating a supply of cartons having their bottom closures sealed and their top closures open comprising, an accumulating conveyor driven at a predetermined speed, a plurality of evenly spaced carriers on said conveyor, means for placing a carton on each carrier, a carton accumulating guideway for stripping the cartons from said carriers and for accumulating a supply of cartons therein, means for maintaining the accumulated cartons in said guideway, means for deflecting one carton at a time from said guideway upon demand and independently of the movement of said conveyor, and means for swinging each carton ninety degrees about an axis normal to the longitudinal axis of the carton immediately after the carton has been deflected from said guideway.

32. In a carton forming and filling machine having a plurality of stations, an accumulating section for accumulating a supply of cartons having their bottom closures sealed and their top closures open comprising, an accumulating conveyor driven at a predetermined speed, a plurality of evenly spaced carriers on said conveyor, means for receiving cartons one at a time at a transfer station at said predetermined speed, means for transferring the cartons from said transfer station onto said carriers at said predetermined speed while rotating each carton ninety degrees about its longitudinal axis, a carton accumulating guideway for stripping the cartons from said carriers and for accumulating a supply of cartons therein, means for maintaining the accumulated cartons in said guideway, and means for deflecting one carton at a time from said guideway upon demand independently of the rate of movement of said conveyor.

33. In a carton forming and filling machine, an accumulating section for accumulating a supply of cartons having their bottom closures sealed and their top closures open comprising, an accumulating conveyor driven at a predetermined speed, a plurality of evenly spaced carriers on said conveyor, means for placing a carton on each carrier, a carton accumulating guideway for stripping the cartons from said carriers and for accumulating a supply of cartons therein, means for maintaining the accumulated cartons in said guideways, means for deflecting one carton at a time from said guideway upon demand and independently of the movement of said conveyor, and a

minimum quantity detector in said guideway for detecting a quantity less than a minimum desired amount of accumulated cartons and for deactivating said deflecting means upon such detection.

34. In a carton forming and filling machine having a plurality of stations, an accumulating section for accumulating a supply of cartons having their bottom closures sealed and their top closures open comprising, two vertically extending accumulating conveyors disposed side by side and continuously driven at a predetermined rate of speed, a plurality of evenly spaced carriers on each conveyor, means for receiving cartons one at a time at an upper transfer station at said predetermined speed for transferring cartons into the carriers of one of said conveyor, means for receiving cartons one at a time in a lower transfer station at said predetermined speed for transferring cartons into the carriers of the other conveyor, rotary transfer means at said upper and lower stations for transferring the cartons from said stations onto the carriers of the associated conveyors at said predetermined speed while rotating each carton ninety degrees above its longitudinal axis, a plurality of ultraviolet lights disposed adjacent one run of each conveyor for sterilizing the cartons as they move therepast, means for guiding the cartons as they move past said ultraviolet lights, a carton accumulating guideway for each conveyor for stripping the cartons from the associated carriers and for accumulating a supply of cartons therein, means for maintaining the accumulated cartons in each of said guideways, means for deflecting one carton at a time from each guideway upon demand and independently of the movement of said conveyors, means for swinging each carton ninety degrees about an axis normal to the longitudinal axis of the carton immediately after the carton has been deflected from said guideway, and means for adjusting said guiding means and said guideways for handling cartons of different sizes.

35. In a carton forming and filling machine, a filling section for first filling cartons having their bottom closures sealed and for thereafter sealing the top closures of the cartons, the combination of a stationary frame, a movable frame, means for filling the cartons and for sealing the top closures thereof supported by said stationary frame at a predetermined distance from said movable frame, an endless transport conveyor carried by said movable frame, a plurality of evenly spaced carton carriers on said transport conveyor for supporting the cartons and advancing the cartons along a predetermined path into registration with said carton filling and sealing means, for driving said conveyor, power driven means for moving said movable frame toward or away from said stationary frame for handling cartons of different sizes, and control means for controlling said power driven means and for determining the extent of movement between the movable frame and the stationary frame to the nearest one-thousandth of an inch so as to accurately control the amount of product filled into different sized cartons.

36. In a carton forming and filling machine a filling section for first filling cartons having their bottom closures sealed and for thereafter sealing the top closures of the carton; the combination of a stationary frame; a movable frame; means for filling the cartons and for sealing the top closures thereof supported by said stationary frame at a predetermined distance from said movable frame;

an endless transport conveyor carried by said movable frame; a plurality of evenly spaced carton carriers on said transport conveyor for supporting the cartons and advancing the cartons along a predetermined path into registration with said carton filling and sealing means; means for driving said conveyor; and means for moving said movable frame toward or away from said stationary frame for handling cartons of different sizes; said means for moving said movable frame comprising a plurality of screw jacks connected between said stationary frame and said movable frame, means interconnecting each of said jacks for simultaneously operating all jacks, an air motor for selectively driving said interconnecting means in either direction, and means for determining the extent of movement between the movable frame and the stationary frame to the nearest one-thousandth of an inch.

37. In a carton forming and filling machine, a filling section for first filling cartons having their bottom closures sealed and for then sealing the top closures, the combination of a stationary frame, a vertically movable frame, adjustment means supported by said stationary frame and operatively connected to said movable frame for vertically adjusting said movable frame relative to said stationary frame, a plurality of turrets, each turret including a stationary column secured to said stationary frame, a rotary column journaled on said stationary column, a turret drive sprocket secured to said rotary column for rotation therewith and for vertical movement relative thereto, means for connecting said sprocket to said movable frame for rotation relative thereto and for vertical movement therewith, a tool-supporting hub secured to said rotary column, a plurality of packaging tools secured at equally spaced intervals around said tool support, each tool on one tool-supporting hub being identical to the other tools on the same hub and being different from any other tools on any of the other tool-supporting hubs, and cam means secured to said stationary column to operate said tool, an endless transport conveyor trained around said turret drive sprocket, drive means supported on said movable frame and connected to said transport conveyor for continuously driving the same, a plurality of carton carriers secured to said transport conveyor at equally spaced intervals therealong for receiving and supporting the cartons in an upright position and for advancing the cartons around the turrets in alignment with the tools thereon, said tools cooperating to fill, seal and mark a carton identifying indicia on each carton, means carried by said movable frame for discharging the cartons from said transport conveyor, and means for actuating said frame adjustment means for raising or lowering said transport conveyor so as to simultaneously adapt all turrets to handle cartons of different heights.

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U.S. Cl. X.R.

53—64, 131, 186, 266, 379; 93—44.1, 53, 59; 141—140, 152, 263; 198—82; 214—6; 271—62

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,456,419 Dated July 22, 1969

Inventor(s) L. VADAS et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 39, change "cast" to -- case --. Column 3, line 54, change "sides" to -- sizes --. Column 5, line 24, after "upon" insert -- by --. Column 6, line 2, change "Figure 4" to -- Figure 64 --; line 73, change "89-29" to -- 89-89 --. Column 14, line 43, change "cartoon" to -- carton --. Column 29, line 16, change "822" to -- 288 --. Column 31, line 15, change "87" to -- 878 --; line 66, change "adjustable" to -- adjusted --; line 68, change "unloading" to -- unloading --. Column 32, line 30, change "mandred" to -- mandrel --. Column 33, line 59, change "bear" to -- gear --; line 60, change "bear" to -- gear --. Column 36, line 38, change "obsence" to -- absence --. Column 38, line 20, change "carries" to -- carriers --; line 34, change "componnts" to -- components --. Column 50, line 29, change "168" to -- 1678 --. Column 51, line 75, change "operate" to -- open --. Column 55, line 43, change "FIGS. 119B and 135" to -- FIGS. 119B and 133 to 135 --. Column 61, line 66, change "118" to -- 2118 --. Column 63, line 50, change "came" to -- cam --. Column 66, line 37, change "247" to -- 2247 --. Column 75, line 54, change "balnks" to -- blanks --. Column 79, line 16, change "1PS-SS" to -- 1PB-SS --; line 17, change "1PS-SS-2" to -- 1PB-SS-2 --; line 18, change "1PS-SS-3" to -- 1PB-SS-3 --; line 19, change "1PS-SS-3" to -- 1PB-SS-3 --. Column 83, line 38, change "fisrt" to -- first --. Column 89, line 49, change "mcachine" to -- machine --.

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Attest:

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